A NEW HANDLING OF THE PLANISPHERE, DIVIDED into three Sections.

IN THE FIRST IS A PLAINE AND
ſenſible explication of the circles of the Sphere,
and ſuch termes as appertaine vnto the doctrine
de primo mobili; after a Methode
not heretofore vſed
in any language.

*THE SECOND SHEWETH HOW VPON
any plaine, being Paper, Paſtboord, or a Latten plate, hauing
one circle diuided into degrees, and croſſed vvith tvvo Diameters
at right angles, moſt Concluſions of the Aſtrolabe
may for all Latitudes or Countries be readily and
exactly performed onely vvith Ruler
and Compaſſes.*

IN THE THIRD, BEING A SVPPLEMENT ORganicall,
is contained the making of certaine eaſie inſtruments for the
perfecter working the former Concluſions, as to know what degrees
and minutes be in any circumference giuen, with
other neceſſarie matters about the Meridian
line and the height of the Pole.

*Pleaſant and profitable generally for all men, but eſpecially ſuch as vvould get
handines in vſing the Ruler and Compaſſe, and deſire to reape the fruite of
Aſtronomicall and Geographicall documents, vvithout being at
the charge of coſtly Inſtruments.*

Inuented for the moſt part, and firſt publiſhed in Engliſh
by THOMAS OLYVER.

AT LONDON
Imprinted by FELIX KYNGSTON, for *Simon
Waterſon* and *Rafe Iacſon*. 1601.

A.p.A32.

6 1880

TO THE RIGHT
WORSHIPFVL SIR
IOHN PETER KNIGHT,
at Thornedon in Eſſex.

KNowing well (right Worſhipfull) after the diſpatch of much weighty buſines, which for the good of others you willingly vndertake, and, by report of the ſhire, with very great diſcretion, and all vprightnes performe, that as it were for your recreation, you peruſed often bookes of Geographie: ſome while ſince I ſent the manner how three or foure problemes Geographicall might bee wrought vpon a plaine with Ruler and Compaſſe only. At my leiſure afterward taking that ſubiect in hand againe, I followed it ſo farre, that I deuiſed after the like way to handle moſt concluſions of the Aſtrolabe, or problemes Aſtronomicall concerning the *Primum mobile*. When I had almoſt brought my purpoſe to effect, it was my chaunce to light vpon *Clauius* his Aſtrolabe, where I found as much promiſed, and performed euen by *Ptolomeis Analomma*, the very modell of *Iohannes de Roias* his Planiſphere, as learned *Guidus Vbaldus* hath fully proued, and alſo the ground vpon which I haue framed much of my worke. Notwithſtanding, perceiuing (as by compariſon euery one may ſee) that except the 5. and 28. taken out of *Manrolycus*, the 14. and 23. out of *Commandine* and *Vbaldus*, my conſtructions were very farre differing from *Clauius*, amending thoſe defects which *Gemma* noteth in *Roias* his worke; beſides taking the matter to be commodious, and not vnpleaſant for trauellers, and all ſuch in generall as delight in Aſtronomicall and Geographicall deuiſes, I ſet light the reproachfull name of an Engliſh Scribler, and tooke courage by publiſhing it to the view of the world, to hazard my ſelfe to euery readers cenſuring. Vpon this reſolution I am bold to vſe your Worſhips name in the front of this booke, teſtifying therby the earneſt and vnfained affection which I beare, and long haue borne both to you and yours: in regard whereof making no doubt, but that this little mite ſhall be gently accepted, with remembrance of my dutie to your Worſhip I take my leaue. *S. Edmunds Bury* in Suffolke, *6.* Ian. 1600. after our Engliſh accompt.

Your Worſhips in all dutie
moſt affectionate,

THOMAS OLIVER.

To the Reader.

SEeing the matters here entreated of admit no eloquence, but muſt in plaine attire be ſimply offered to the view, though I could (gentle Reader) I would not flouriſh with thee, in pleading for my ſelfe or this treatiſe: therefore referring all to thy friendly cenſure, I will ſpend this voide paper in aduertiſements for the better vnderſtanding, and eaſier performing of that which is deliuered.

The fitteſt matter, whereupon you may worke theſe concluſions following, will be a plate of braſſe, and the Compaſſe, Pritchet, Pointer or Steele, wherewith you muſt draw your lines, would be either of the ſame ſubſtance, or els Iron rather than Steele: for if you make not your ſtrokes verie deepe, by rubbing the plate with a wet Pumice, you may eaſily take all out when you will, and thereby alſo tarriſh or darken it in ſuch ſort, that you may preſently at your eaſe, and very exactly draw, and worke vpon it againe.

When you begin to practiſe, it will helpe very much to work one concluſion by it ſelfe, and to note the lines, as you draw them, with the characters, that are named in the peculiar conſtruction: but when you are ſomething perfect, this ſhall not neede.

You may alſo, hauing a quadrant diuided, make any paper ſerue the turne for theſe purpoſes. Opening your Compaſſe to the diſtance of 60. degrees, at that diſtance diſcribe a circle, and ſubtending foure times in it a line equall to that line, which ſubtendeth the quadrants circumference, *if you ioyne the oppoſite points, it ſhall be croſſed with perpendicular Diameters, then transferring the circumferences giuen or found from the quadrant to the circle, or from the circle to the quadrant, you may finde the quantitie of any circumference as well, as though your circle were diuided into degrees.*

Where you deſire exactnes, you muſt reſt neither on this way, nor on the inſtrument in the beginning of the ſecond ſection, but vſe that quadrant which you are taught to make in the beginning of the third ſection, by it you may know the iuſt content of any giuen circumference in degrees and minutes exactly, and let this be a generall warning for all concluſions.

I haue barely ſet downe the conſtructions without demonſtrations, as the fitteſt for their capacities, whoſe good I ſpecially aime at: yet is there nothing here propounded that hath not demonſtratiuely been examined: and for experimentall triall the working by theſe concluſions may be compared with tables calculated for the ſame purpoſe, which, if handines and diligence be vſed, will agree.

Since my writing of the ſecond ſection, I haue found how the concluſions therein omitted may bee perfectly wrought without the helpe of any Elleipſis, *and all contained within the compaſſe of the limbe: but at this time I thought not good to adde them.*

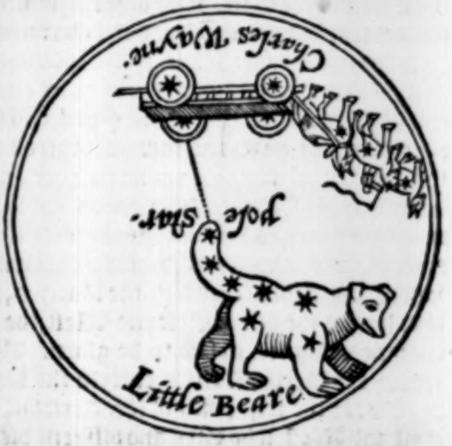
Thus much (gentle Reader) I thought meete thou ſhouldeſt be aduertiſed of: and ſo deſiring thee to pardon the eſcapes of my penne, if thou meeteſt with any, I commend thee and thy honeſt ſtudies to our Lords holie direction.

Thine Thomas Olyver.

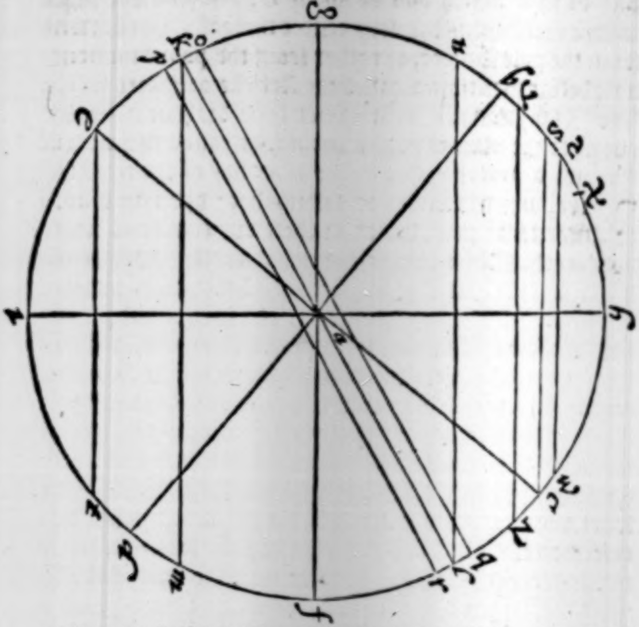
A new handling of the *Planiſphere.*

THE FIRST SECTION, WHEREin is contained a plaine and ſenſible declaration of the circles of the Sphere, and the termes vſed in the doctrine *de primo mobili*, after another Methode than is yet in any other language.

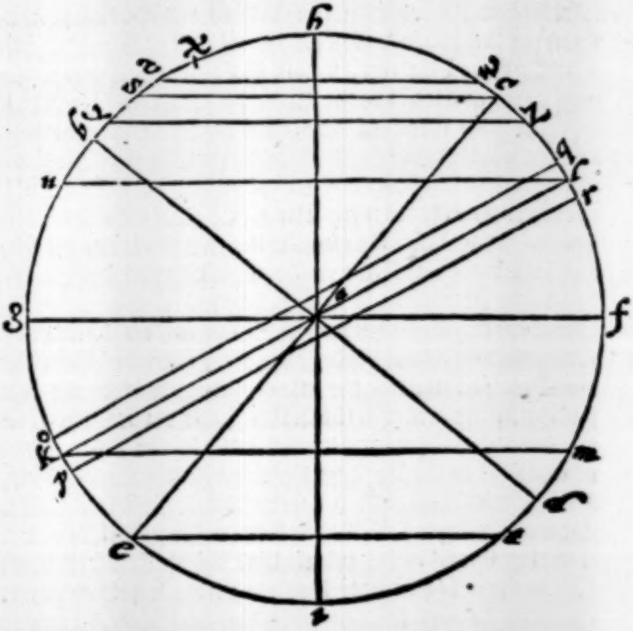
THE circles of the Sphere haue more than once alreadie bin written of in English: notwithſtanding I think it wil not be accounted labour loſt, though it were only for the better vnderſtanding of the concluſions following, here to handle them againe as principles in the beginning of this treatiſe. Ariſtotle and Prolomey for proofe of ſome matters here propounded, haue vſed many exquiſite arguments, which I meane not to proſecute, but hoping from the teſtimonie of ſenſe in ſuch manner to deduce the poſitions, that any meane capacitie may haue ſo reaſonable a conceit of them, that with probabilitie they may eaſily be admitted, I will referre their exact and more ſubtile demonſtration, with the reproofe of ſuch as impugne them, to ſome others handling, or to ſome other place. Therefore requiring firſt the reader not to caſt vntimely doubts, nor haſtily to iudge of any part by it ſelfe, before he hath conſidered, and in ſome manner vnderſtood the whole diſcourſe, I will according to Hippocrates his counſell begin with the notableſt and eaſieſt things. Whoſoeuer doth but caſt vp his eyes vnto heauen, preſently perceiueth that it compaſſeth him round about in manner of halfe a globe or an Hemiſphere: and if he ſtand vpon ſome high place, or be at Sea farre from land, where nothing can be ſéene but water and the Skie, his eye, if he turne himſelfe about, will repreſent vnto him at the loweſt bounds or limits, which he ſeeth, the faſhion of a circle, vpon whoſe plaine, as vpon a baſe, this viſible Hemiſphere ſeemeth to be placed: therefore that Circle was firſt in Gréeke, and is now commonly in Engliſh called the Horizon, that is to ſay, bounding or limiting, vz. the compaſſe of your ſight. The largenes of this Circle, euen as it falleth vnder view, is of ſo great a compaſſe, as you neede not reſtraine the center thereof, according to the preciſe Mathematicall definition, to one determinate, exquiſite, indiuiſible, and very poynt, or pricke, but without ſenſible error, as your eye will plainly teſtifie, any one at pleaſure may bee taken in the place where you ſtand. From a center ſo taken, if there be, or be imagined, a plumbe line or line perpendicular to the plaine of the Horizon extended vnto the heauen, the place, which there it toucheth, is commonly called by an Arabian name the Zenith, being in truth the pole of the Horizon, and the line it ſelfe his Axis. By this Axis, and any lines croſſing it, if plainnes be euery way extēded reaching vnto heauen, they marke out their circumferences, or ſemicircles, cutting one another in the Zenith: but in the Horizon their ſections are right lines, cutting one another in his center. Thoſe circles are named Azimutes, and are imagined by Aſtronomers to be cut by other circles parallel to the Horizon, which they terme Almicantars and circles of Altitude, becauſe the portion of the Azimute, which is betwéene the Horizon and the Parallel, ſheweth how hie aboue the Horizon that poynt of the Parallel is, by which the Azimute paſſeth. Furthermore, in a cleere night beholding the bright ſhining Starres, you ſhall euidently perceiue how they change their places continually, ſome to riſe and ſhew themſelues, other to goe downe vnder the Horizon, and to be hidden from your ſight, onely if you place your ſelfe ſo, that your right hand be towards their riſing, and your left hand toward their going downe, looking right forth, and ſomewhat vpward, you ſhall behold certen Starres, which are all times of the night to bee ſeene, and neuer go down; amōgſt ſome of which placed after this faſhion, there is one commonly called the Pole ſtar, which being the laſt in the tayle of the conſtellation called yͤ little Beare, lyeth in māner directly as it were in a right line, with thoſe two in the hindermoſt wheeles of Charles his wayne. This Starre ſeemeth little or nothing to remoue out of his place, and indeede not farre from it there is a poynt, or pricke, which remaineth in one and the ſame place alwaies immoueable. The Azimute paſſing by the Horizons Axis, and a right line drawne frō this immoueable point, or the pole ſtarre, is properly called the Meridian circle; the common ſection of it and the Horizon, being a right line, is the Meridian line, or the line of North and South; the right line, which croſſeth this Meridian line at right angles in the center of


Charles Wayne.
pole star.
Little Beare

the Horizon, is called the line of true Eaſt, and true Weſt, or ſimply the line of Eaſt and Weſt, which poynts the ends thereof extended directly fall vpon. The Azimute ſtanding vpon this line, Ioannes de Roias, & others, ſpecially ſuch as write of Dyalling, as it were for dignitie and preheminence, doe call the Verticall circle: which name being common to all Azimutes, becauſe they paſſe by the Zenith, in Latin called Vertex. or punctum eregione verticis: for a diſtinction Gemma Froſius hath named it the Circle of the Eaſt. The other Azimutes haue no proper names, but are meaſured or determined in the Horizons circumference. That, and ſo likewiſe all other Circles, Aſtronomers doe imagine to be diuided into 360. equall parts, which they name degrées, that is to ſay, euerie quarter or quadrant into 90. degrees: euery degrée they further diuide into 60. minutes, euery minute into 60. ſeconds, euery ſecond into 60. thirds, and ſo continue ſometimes vnto tenths, and may goe further if they will. By theſe degrees, minutes, &c. which are betwéene that point, where any Azimute cutteth the Horizon, and the Meridian line, or the line of Eaſt and Weſt, the Azimute is determined, aſſigned, or ſaid to be giuen. Vpon the points where the Verticall circle cutteth the Horizon, which poynts are the true poles of the Meridian, and the preciſe Eaſt and Weſt, if by often and diligent viewing you ſhall ſee two Starres, the one in the Eaſt, and the other at the ſame time right againſt it in the Weſt, in winter time euen in one night, you may behold that which is in the Eaſt firſt aſcending, and then againe deſcending at length to come into the Weſt, and that which was in the Weſt being till that time hidden from your ſight, then to appeare againe riſing in the Eaſt: all this while continually the like ſhape of an Hemiſphere being ſtill repreſented to your eye, without any chaunge or alteration, whereby you may gather the heauen to bee a perfect Globe, or Sphere, hauing that part vnder the Horizon equall and like to that which you ſee aboue it, and that the place where you ſtand is the very center thereof. A line drawne from the pole Starre, or rather from the poynt immoueable before mentioned, called the Articke, or North pole, a line (I ſay) drawne, or imagined to be drawne from that poynt to the place of your ſtanding, is called the Axis of the world, and extended to the other ſide of the celeſtiall Sphere, which is vnder vs, falleth there vpon the South or Antarcticke pole, which in theſe our countries neuer appeareth. Theſe things, being but a little heedily conſidered, be ſo manifeſt and apparant, that neither example nor figure is greatly requiſite for the perfect vnderſtanding of them: yet in this beginning to remoue all difficultie, and to make euery thing as plaine as may be, doe thus much: In ſome plaine ground, or rather vpon a poſte, or ſtone, or ſome ſuch like thing made exactly ſmooth, and lying very flat, without any manner of leaning or declining, which you muſt warily and diligently trie by your leuel, and your plumbe line, take the center A, vpon which deſcribe a circle B C D E, repreſenting the Horizon, whoſe circumference you may diuide, or imagine onely to be diuided into degrees, and from A, the center thereof, erect a Steele or wier, ſtanding plumbe vpright, or perpendicular to the flat of the circle A B C D, by triall of your plumbe rule: then take a boord made preciſe ſquare, hauing the ſide ſomewhat longer than the ſemidiameter of the circle B C D E, and ſet one corner thereof in the center A, ſo that one of the ſides containing it, may agree iuſt with the Steele or wier, and the other with the circles plaine: then looking along the vpper edge, or through two ſights ſet vpon the edge, and continually lifting it vp without ſwaruing, till the ſide that lay vpon the flat of the circle agree with the Steele: the line of your ſight, or the line drawne from the center (for in reſpect of the heauens mightie diſtance, the difference betweene them is not ſenſible) ſhall, howſoeuer the ſquare be placed, deſcribe



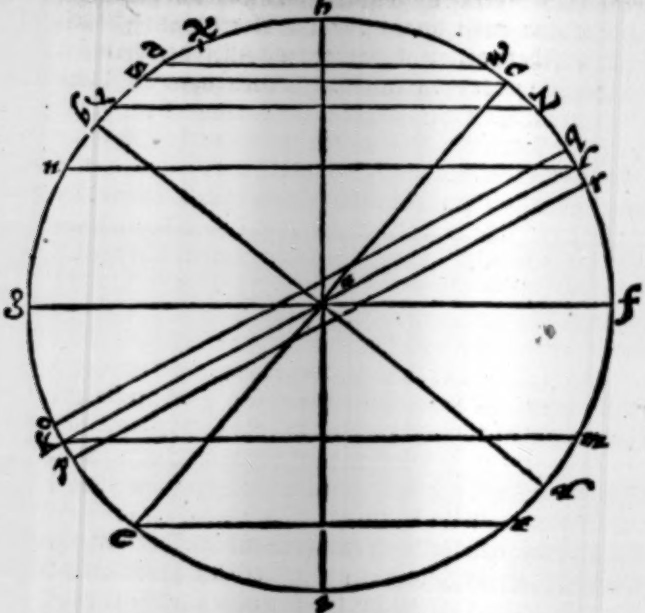
an Azimute. And if ſtaying the edge of the ſquare at one height, the corner be continually kept in yͤ center without ſlipping, by turning it round about the Stæle, you ſhall deſcribe an Almicantar, parallel to the Horizon. In this manner, carying the ſquare about, & lifting it vp & downe, till you ſee the Pole ſtarre, or if you can aime at it, the often ſpoken of immoueable poynt, ſtaying it faſt in that ſituation, either of the edges without ſenſible error may bee taken for the Axis of the world, which extended falleth on both the Poles, that which is ſeene being the Arctick Pole, and the Antarctick that which is vnder the Horizon. In lifting it vp and downe, you ſhall in the heauen poynt out the Meridian circle, and bringing it iuſt to the flat of the circle B C D E, the edge will there ſhew the right line B D, which is the Meridian line. The line C E, in A croſſing the line BD, is the line of right Eaſt, and right Weſt: the Azimute ſtanding vpon CE, is the Vertical circle, or the circle of the Eaſt: the Azimute ſtanding vpon GF, is ſometime ſaid to be of ſo many degrees, as are betwéene B the North poynt of the Horizon, and G, where the Azimute ſtanding vpon GF cutteth the Horizon, vz. the circumference BG, denominateth the Azimute ſtanding vpon GF, and ſometime that circumference GE, which containeth the number of the degrées betwéene the ſame poynt, and the line of Eaſt and Weſt EC, which bée the very poles of the Meridian. Working by the Pole ſtarre, theſe things will ſomewhat varie from exactnes, which ſome helpe by awayting the time, when the ſtarre next the whéeles of Charles wayne, commonly called the filler or hill horſe, is directly ouer or vnder the Pole ſtar, ſo that the ſquare, being lifted vp and downe cloſe by the Stéele, paſſeth by them both. But howſoeuer, this may ſuffice for ſome conceit of theſe termes, hereafter ſhall be taught other moſt preciſe waies, to diſcribe and take them moſt exactly. To returne againe therefore to our principall purpoſe, in beholding of the Starres, how they continually riſing in the Eaſt ſide of the Horizon, aſcend vnto the Meridian, and ſo from thence deſcend vnto the Weſt ſide, you ſhall obſerue, that alwaies they kéepe their diſtance from the Pole ſtarre, or the true pole vnchaunged: as if you mark the two hinder whéeles of Charles waine, you ſhall finde, howſoeuer they be ſituated in the heauen, that their diſtance from the Pole ſtarre is alwaies one, and the ſame not néerer or farther of at one time then an other, and therefore euery ſtarre or poynt, by ſuch motion in a Globe or Sphere, his ſuperficies deſcribeth the circumference of a circle: ſo that the whole heauens muſt ſéeme to turne vpon the poles, and make a circular motion or reuolution. This motion in diuers reſpects hath diuers names, called ſometime the Diurnall motion, ſometime the motion of the firſt moueable heauen, ſometime Notus capeus. Againe, euery Starre or poynt by this conuerſion deſcribing a circle, if you take ſome ſtarre, or poynt, which lieth betwéene the poles iuſt 90. degrées from either of them, that will deſcribe a circle, paſſing by the poynts of Eaſt and Weſt, which for ſome reaſons hereafter to bee expreſſed, is called the Equinoctiall. The other poynts or ſtarres deſcribe circles parallel to the Equinoctiall circle, which be called circles of declination, becauſe, if from the poles of the world, by any point taken in any of the parallels, a greateſt circle be drawne to the Equinoctiall, that portion of it, which lieth betwéene the Equinoctiall and the Parallel, is called the declination of the poynt ſo taken. Some of theſe Parallels towards the North, deſcribed by reuolution of the poynts or ſtarres, that neuer ſet, are whole aboue the Horizon, and one of them, which ſome name the Arctick circle, toucheth it onely: about the Antarcticke pole there be ſome wholy vnder the Horizon, and one, which ſome call the Antarcticke circle, only toucheth it in the South poynt: other betwéene theſe two touching Parallels, which ariſe and ſet or goe downe, cut the Horizon, whoſe portion lying betwéene that poynt and the true Eaſt or Weſt, is called the Amplitude or Latitude of the riſing, or the ſetting of the poynt deſcribing the Parallel. Theſe things hitherto rehearſed, trauellers may euery where and in all countries obſerue: and beſides, in their iournies Southward or Northward, they ſhall ſee ſometimes more, and ſometimes fewer ſtars neuer to goe downe: more in going Northward, fewer in going Southward, yet alwaies without alteration kéeping one and the ſame diſtance one from another. Mary the Pole ſtarre or the true pole, proportionablie to the length of the way trauelled, altereth his diſtance from the Horizon, and the Zenith appearing, the further you goe Northward, the higher, & the further you go Southward, the lower, and ſo accordingly that portion of the Meridian, betwéene the Equinoctiall and the Zenith, which is



called the Latitude of the countrie, being alwaies equall to that which is betwéene the Hoꝛizon and the Pole, called his height, oꝛ eleuation, is of neceſſitie greater oꝛ leſſer: ſo that your ſituation is apparantly chaunged in reſpect of the heauen, but yet ſtil you kéepe the ſame diſtance from it, wherby you may eaſily inferre the figure oꝛ ſhape of the Earth to bee like and anſwerable to the celeſtiall Sphere: and that how vaſt and huge ſoeuer it be in it ſelf, yet in compariſon of the large compaſſe of the heauen, it is iuſtly counted foꝛ no moꝛe but a ſmall poynt, oꝛ pꝛicke: foꝛ it neuer hindꝛeth you from ſeeing the pꝛeciſe halfe of the celeſtiall Sphere, which, were the bignes thereof any thing of accompt, it would of neceſſitie doe. Foꝛ better vnderſtanding of theſe matters, imagine the circle BCDE, deſcribed on the center A, to repreſent the Meridian, and vpon the line E C, a ſemicircle erected perpendicularly to repreſent the Horizon, whoſe Pole, or the Zenith, the poynt B is, and let H be the North pole. From H to A the place of your ſtanding (being the center of the Horizon and the whole Sphere, and ſo conſequently of al the greateſt circles in the ſame Sphere deſcribed) from the pole H to the center A draw a right line, and extend it vnto I: the line H I is the Axis of the world: the poles be H the North, and I the South, or Antarcticke pole. Let the poynt G, taken in the Meridian, be iuſt 90. degrees from either pole, ſo that the circumferences G H, G I, be iuſt quadrants: by the reuolution of the Sphere vpon the poles H I, which is the Diurnall motion, the line G A ſhall deſcribe a circle paſſing by the center of the Sphere, and perpendicular to the Meridian: therefore it muſt paſſe by the poles thereof which be in the Horizon, the points of Eaſt and Weſt, as the circle ſet plumbe vpon the Diameter F G will doe. Other poynts, as S, N, V, deſcribes circles parallel to that ſtanding vpon G F, of which that which ſtandeth vpon C S, doth onely touch the Horizon, and is wholy aboue it: the other beyond it to the pole-ward, as V, W, be wholy aboue it, and come not néere. So likewiſe E, T, is alwayes vnder the Horizon, and only toucheth it: the other beyond it towards I, are vnder it, and neuer come néere it. Now if in going Northward the pole H grow higher, the Equinoctiall muſt go further from the Zenith: for ſeeing B C and G H be equall, that is the iuſt quarters of the ſame circle, if you take away the circumference B H common to them both, the reſidue G B, the diſtance of the Equinoctial from the Meridian, which is the Latitude of the countrie, whoſe Zenith is B, is equall to H C, the height of the pole aboue the Horizon, or the eleuation of the pole, and as the pole riſeth higher, ſo is the circle S C remoued from the Horizon further and further: whereby you ſee, that by that meanes more ſtarres neuer ſet. The circumferences of the Meridian GN, GS, GV, are called the declinations of the points N, S, V, taken in the parallels NZ, SC, VW, and the portion of the Horizon betweene the point of true Eaſt, and the poynt, where the parallel ſtanding vpon NZ, cutteth the Horizon, is the amplitude or latitude of riſing of the poynt L, or any other taken in the parallel, ſtanding vpon the Diameter NZ. Theſe things being well conceiued, let vs conſider againe, that as apparantly as any ſtarre, the Sunne making his reuolution, ariſeth on the Eaſt ſide of the Horizon, and mounting vp vnto the Meridian, at which time it is high noone, deſcendeth againe vnto the Weſt ſide, which time of his continuance aboue the Horizon is called the artificiall day, then being hid from our ſight, the night beginneth, which continueth till the Sunne, paſſing by that part of the Meridian, which is vnder the Earth, when it is midnight with vs, returneth againe vnto the Eaſt ſide, making vp the naturall day, which is the ſpace of time from the Sunne riſing to the Sunne riſing againe, and may bee indifferently reckoned from Sunne ſet to Sunne ſet, as the Iewes doe, or from midnight to midnight, which is our common accompt. The obſcure light before the Sunnes riſing, is called the dawning and breake of the day: after his ſetting is called the twilight, Crepuſculum in Latin is a common name to both times. Although in the Sunnes daily reuolution we obſerue all this, yet is it not without much varietie and chaunge: his riſing and ſetting is not alwayes in one place of the Horizon, nor his height in the Meridian alwayes the ſame at noone. In the middeſt of winter, about the 12. of our December, when the daies be ſhorteſt, and the nights longeſt, it riſeth & ſetteth moſt Southerly, and is loweſt in the Meridian at noone: towards the Spring, as the dayes waxe longer and longer, in riſing and ſetting it continually groweth from the South, and mounteth higher and higher in the Meridian, till about the 11. of our March, making the day and night equall, it riſeth and ſetteth iuſt Eaſt and Weſt, comming at noone to the common ſection of the Equinoctiall and the Meridian: then, as Summer commeth on, the dayes encreaſing, it riſeth and ſetteth more Northerly, mounting ſtill higher and higher in the Meridian at noone, till in the middeſt of Summer, the dayes being at the longeſt, about the 12. of our Iune, it be at the higheſt in the Meridian at noone, and riſeth and ſetteth furtheſt North: then, as the dayes ſhorten, it returneth backe againe, growing continually lower at noone, and riſing and ſetting leſſe Northerly, till the dayes and nights become equall againe, about the 13. of our September, when it riſeth and ſetteth preciſely Eaſt and Weſt againe, and at noone will be in the common ſection of the Equinoctiall and the Meridian. From that poynt it groweth lower and lower at noone, riſing & ſetting more and more Southerly, as the nights encreaſe, till about the 12. of our December the dayes being at the ſhorteſt, it becommeth loweſt againe at noone, and in riſing and ſetting moſt Southerly, as it was before. Of this returning from the higheſt in Summer, and the loweſt in winter, the two Parallels, which it then deſcribeth by the Diurnall reuolution, bee called Tropickes, and the Equinoctiall was ſo named, becauſe in March and September the Sunne comming to it, the day is made equall to the night. By theſe varieties it was eaſily gathered, that the Sunne made a peculiar courſe beſide his Diurnall reuolution, in a greateſt circle touching the two Tropicks, and declining from the Equinoctiall, which it diuideth (as all greateſt circles doe one another) into two equall parts, or ſemicircles. This declining circle, becauſe when the Sunne and Moone either meete or be oppoſite in it, there happeneth an Eclipſe, is called the Eclipticke, and ſometime the Zodiacke: but the Zodiacke properly is a ſuperficies like a fillet or a girdle, laid vpon this circles circumference, comprehending on either ſide of it ſixe, or (as ſome ſay) eight degrees. The poles of

this circle, which decline from the poles of the world, as
the circle it ſelfe declineth from the Equinoctiall, deſcri-
beth by the Diurnall reuolution two Parallels, which
ſome, in ſtead of them afore deſcribed, take for the Articke
and Antarcticke circles. That ſection of the Equinoctial
and the Eclipticke, which the Sunne commeth to in the
Spring time, is called the Vernall ſection: that which is
oppoſite to it, by which the Sunne paſſeth in the end of
Harueſt, is the Autumnall ſection: the poynts which
touch the Tropickes, bee commonly called Solſtitiall
poynts. The greateſt circle, paſſing by the Equinoctiall
ſections and the poles of the world, is the Equinoctiall
Colure: that which paſſeth by the poles of the world and
the Solſtitiall poynts, is called the Solſtitiall, or Tropi-
call Colure, the portion thereof lying betwéene the two
Tropickes, is the diſtance of the Tropickes, whoſe halfe
is the Sunnes greateſt declination, otherwiſe called the
Obliquitie of the Zodiacke, which by obſeruation made
with large inſtruments, is in this our age found by great
Artes-men to be 23. degrées and 30. minutes, whoſe re-
7 port it ſhall be ſufficient to accept of, and commit to me-
morie, without taking or trying it by any ſmall inſtru-
ment: though ſome writers of the vſe of the Aſtrolabe
haue made that one of their ſpeciall concluſions. The E-
quinoctiall and the Eclipticke, are circles of chiefe ac-
compt: the firſt being the rule and meaſure of the firſt mo-
tion, or the motion of *Primum mobile*, otherwiſe called
the Diurnall reuolution: and the other as it were the
Standard, whereby all ſecondarie motions are exami-
ned: therefore the degrées of theſe circles haue peculiar
names, called in the Equinoctiall *Tempora*, times, becauſe
they be the firſt meaſures of time, euery 15. degrées aſcen-
ding making an houre, and ſo the whole reuolution of
360. which is performed euery naturall day, make 24.
houres. Aſtronomers begin to accompt the parts or de-
grées, as well in the Equinoctiall, as in the Eclipticke,

from that poynt common to them both, which is called the Vernall ſection: and though in the Equinoctiall there be no chaunge of names, yet in the Eclipticke or Zodiacke euery thirtie degrées is called a ſigne, and hath a peculiar name. The firſt 30. immediatly following the Vernall ſection, is called Aries: the next 30. Taurus, the third 30. Gemini, the fourth 30. (whoſe firſt point begin a new quadrant, and toucheth the Summer Tropicke) is termed Cancer: the fift 30. Leo, the ſixt Virgo. Theſe ſixe Signes make vp the ſemicircle of the Zodiacke, which leaneth or declineth from the Equinoctiall toward the North pole. The firſt 30. after this ſemicircle, beginning at the Autumnall ſection, make the ſeuenth ſigne, named Libra: the next or eight 30. is the ſigne Scorpio: the ninth 30. is Sagittarius: the tenth 30. (beginning a new quadrant with the firſt poynt, which toucheth the winter Tropicke) is Capricornus: the eleuenth 30. is Aquarius, and the twelfth 30. is Piſces. There be characters vſed to expreſſe euery Signe with, which are found in euery Almanacke. The Sunne paſſeth in the Ecliptick from poynt to poynt, making his continuall reuolution in it, without ſwaruing to the one ſide or the other: other Starres for the moſt part decline from it, but yet haue their places determined by Longitude and Latitude in reſpect thereof thus: By any poynt or Starre, a greateſt circle being drawne from the pole of the Ecliptick to his circumference, the ſection there made, or the portion of the Ecliptick betwéene that ſection and the Vernall ſection, is the Longitude of the poynt, or Starre, by which the greateſt circle is drawne: his Latitude is that portion of the ſame greateſt circle lying betwéene the Starre and the Eclipticke. The Sunne being in any poynt of the Eclipticke, and the poynt it ſelfe, with all other Starres, whereſoeuer placed beſides, are in like manner compared to the Equinoctiall, and in reſpect thereof, not onely their declination, which hath béen touched before, but alſo their right Aſcenſion is conſidered. A greateſt circle being drawne from the Poles of the world to the Equinoctiall, by any poynt or Starre, his right Aſcenſion is that portion of the Equinoctiall, taken betwéen that poynt where the greateſt circle cutteth, and the Vernall ſection. The declination is the portion of the greateſt circle ſo drawne, which lieth betwéene the Equinoctiall and the Starre, which (as before was noted) is alſo determined by a Parallel to the Equinoctiall, paſſing by the Starre. The right Aſcenſion is ſo called, becauſe vnder the Equinoctiall, that is, in a Situation where the Equinoctiall paſſeth by the Zenith, and the Horizon by the Poles of the world, the Horizon (by which once in 24. houres euery poynt aſcendeth) doth the office of any greateſt circle ſo drawne, as is appoynted, and agréeth with it moſt exactly. This Situation is called *Sphæra recta*, the right Sphere; and the Horizon in that Situation, *Horizon rectus*, the right Horizon: but when the Equinoctiall declineth from the Zenith, and the Poles bée one aboue, the other beneath the Horizon, that Situation is called the Oblique, or Declining Sphere; and the Horizon, the Oblique Horizon, which neuer agréeth with the foreſayd greateſt circle, drawne by the Poles of the world: and therefore with the Starre there is another poynt of the Equinoctiall in the Horizon, betwéene which and the Vernall ſection is contained that portion of the Equinoctiall, that is called the Starres Oblique Aſcenſion, and the portion of the Equinoctiall betwéene the ends of the right and Oblique Aſcenſion, is called the Difference Aſcenſionall. But for helping the conceit of theſe things, I will vſe a linearie example, taking the former figure, where E C is the Meridian line, and the Diameter on which the Horizon ſtandeth, now in the middeſt of winter the Sun being loweſt in the Meridian, in the point K, by the Diurnall reuolution, deſcribeth a Parallel ſtanding vpon the Diameter K M, which cutteth the Horizon from the Eaſt towards the South: it continually groweth higher and



higher in the Meridian pan, & riſeth in the Horizon néerer and néerer the Eaſt, till about the 11. of March at noone it commeth to G, the ſection of the Equinoctiall and the Meridian, and then by the Diurnall reuolution deſcribeth a circle iuſt anſwering the Equinoctiall, which paſſing by the poynts of Eaſt and Weſt in the Horizon, ſtandeth vpon the Diameter GF: from thence, as Summer commeth on, it aſcendeth in the Meridian, and riſeth more Northerly vpon ẏ Horizon, til about the 12. of our Iune, being at the higheſt in N, it deſcribeth a Parallel ſtanding vpon the Diameter NZ, in which it riſeth vpon the Horizon furtheſt frõ the Eaſt to the Northward: from thence it deſcendeth againe by G, to K, and paſſeth in the Horizon by the true Eaſt to the furtheſt Southward, then it aſcendeth againe till it come to N, continually returning from the higheſt to the loweſt, & from the loweſt to the higheſt: whereof the two Parallels ſtanding vpon the Diameters K M, L N, be called Tropickes. By theſe changes it was eaſily gathered, that the Sunne (beſides the Diurnall reuolution) made another proper to it ſelfe in a circle ſtanding vpon the Diameter K L, drawne from Tropicke to Tropick by A the center of the Sphere: by reaſon whereof, this circle, called the Eclipticke, and the Equinoctiall, diuide the one the other into two ſemicircles. The Eclipticke is ſometimes called the Zodiacke, though properly the Zodiacke be a ſuperficies lying on either ſide of it, as you ſee the ſuperficies O P Q R, parted by the line Z K. The common Diameter of the Equinoctiall and the Ecliptick ſtanding in A, perpendicular to the plaine of the circle B C D E, the poynts K and L being the Solſtitiall poynts, the circle B C D E is the Solſtitiall Colure. The circle ſtanding vpon I H, and paſſing by the perpendicular Diameter, or the Equinoctial ſection, is the Equinoctiall Colure: the circumference K N is the diſtance of the Tropicke, the one halfe thereof G K, or G N, is the obliquitie of the Zodiacke, or the Suns greateſt declination, for it groweth leſſe & leſſe as it cōmeth neerer the Equinoctiall ſection: where it hath no declination at al, it neuer declineth from the Eclipticke or circle ſtanding vpon K Z, but make his motion in it, his place is named of the poynt wherein it is. Other Starres or poynts without the Eclipticke (as for example, S) haue their place determined by a greateſt circle B C D E, drawne from X, the Pole of the Zodiacke, by S, to K, a poynt in the Ecliptick circumference, the portion of the Ecliptick betweene the Vernall ſection and K, or the poynt K is the Longitude of S, and the circumference S K, is his Latitude. In like manner, if by any ſtarre or poynt Y, and the Poles of the worlde H I, there bee drawne a greateſt circle B C D E, cutting the Equinoctiall in G, the portion of the Equinoctiall betweene the Vernall ſection and G, is the right Aſcenſion of Y, and the circumference G Y is his declination. Now if G, the ſection of the Meridian and the Equinoctiall, be the Zenith of any place, the Horizon muſt ſtand on I H, and paſſe by the Poles of the world, which ſituation is called the right Sphere, and the Horizon the right Horizon, wherein, by the Diurnall reuolution twice in 24. houres, the circle B C D E muſt ioyne cloſe with it. But if G, the ſection of the Equinoctiall and the Meridian, decline from B the Zenith, which ſituation is called the Oblique Sphere, and the Horizon then ſtanding on E C, being an Oblique Horizon, by the Diurnall motion made vpon the Poles H I, the circle B C D E can neuer agrée or match euenly with the Horizon: therefore of force ſome other poynt of the Equinoctiall, and not G, muſt be in the Horiſon with Y: the circumference of the Equinoctiall betwéene that point in the Horizon, and the Vernall ſection, is the Oblique Aſcenſion of Y: but the portion that lieth betwéene that poynt and G, is the difference Aſcenſionall. That poynt of the Zodiacke, where it is cut off the Meridian, is called Medium cœli, mid heauen; Culmen and cor cœli aboue the Horizon, & Imum cœli vnder the Horizon, the leſſer angle, made by that ſection, is called the Meridian angle. The poynt of the Eclipticke, that is in the Eaſt ſide of the Horizon, is called the Aſcendent, and the Horoſcope, the ſection there make the angles, of which the leſſer is called the Horizontall angle: the quantitie thereof is equall to the Nonageſimus Gradus of the Ecliptick, which is peculiarly giuen to that poynt of it, which is iuſt 90. degrées from the Aſcendent. There be moreouer other greateſt circles to be conſidered, which are called circles of poſition, or circles of Station, ſixe of them diuiding the heauen in twelue portions, which are called houſes or Stations, though many times thoſe names be reſtrained only to ſuch parts of the Zodiack, as be intercepted by thoſe circles. Though the Horizon be alwaies taken for one, and the beginning of the firſt houſe: yet are the reſt by diuers diuerſly drawne. Some will haue them all to haue the Meridian line for their common Diameter, and yet agreeing in this make difference in placing them. Campanus and Gazulus diuide the Verticall circle into twelue equall parts, and by euery two oppoſite ſections draw a circle of poſition. Regiomontanus diuideth the Equinoctiall into twelue equall parts, and will haue euery circle of poſition paſſe by two of thoſe oppoſite ſections: both theſe waies keepe the Horizon and the Meridian for circles of poſition. Other diuide the Zodiacke into twelue equall parts, beginning at the Aſcendent, and two of thoſe oppoſite ſections draw from the poles of the Zodiacke their circles of poſition: theſe keepe the ſame Aſcendent that the former doe, but muſt differ many times in the tenth houſe, or the Cardo medij cœli, though Gemma writeth that all agree about the foruer Cardines, that is the Horoſcope, ſeuenth houſe Culmen, and Imum cœli: for they cannot haue alwaies the Meridian & the Horizon for circles of poſition. Other draw theſe circles from the poles of the world, and that diuerſly: but the three former wayes are in greateſt eſtimation. A circle of poſition differeth from an angle of poſitiou, which (after Ptolomey) is an angle at the Zenith, ſubtended of that portion of the Horizon, which lieth betweene the Meridian and the Azimute, paſſing by the Zenith of the other place, vnto which the poſition belongeth. Gemma Friſius maketh it a right lined angle in the center of the Horizon, ſubtended of the ſame circumference: by it Topographicall deſcriptions are made, wherein ſometimes the diſtance of two places is meaſured by a right line lying betweene them, but in a Sphericall ſuperficies by the portion of a greateſt circle, becauſe that is the ſhorteſt that can bee drawne in it. Theſe things may be eaſily conceiued without linearie explication, if the former matters bee well vnderſtood: therefore as it were beſides the principall purpoſe, ſetting downe how by ſupputation you may readily geſſe ſomewhat neere the Suns place, being a thing for many purpoſes to be had in a readines, I will end this firſt ſection: the thing is taken out of Clauius, but fitted to our common, or the Iulian yeere.

Parergon primum.

What moneth, and what day of it, the Sunne entreth euery ſigne of the Zodiacke.

FIrſt tell the moneths vpon your fingers, ſeeking Ianuarie on your thumbe, Februarie on your forefinger, and ſo the other in order, till you come to your moneth, which marke on which finger it falleth: in like manner tell the Signes, beginning with Aquarius on your thumb, Piſces on your forefinger, and ſo the reſt in order, till you come to the finger, on which your moneth fell: the Signe which falleth on that finger, the Sunne entreth that moneth. Then learning theſe two verſes by heart:

Inclyta Laus Iuſtis Impenditur, Hæreſis Horret
Garrula, Grex Gratus Fauſtos Gratatur Honores.

In like manner ſet Inclyta on your thumbe, and word by word in order, till you come to the finger, on which your moneth fell: then telling from A in the croſſe row, till you come to the firſt letter of your word, take that number and ſubtract it from 20. the reſidue is the day of the moneth, when the Sunne entreth the Signe. For example: I would know what Signe the Sunne entreth in October, and what day it entreth, telling from Ianuarie vpon my fingers the moneths in order: at the ſecond going ouer I finde October on my little finger: then taking the Signes, and telling from Aquarius, at the ſecond going ouer my fingers, Scorpio falleth on my little finger, ſo I ſay that the Sunne entreth Scorpio in October: then taking the verſes, and ſetting the words one by one in like manner on my fingers, I finde in the ſecond going ouer, Fauſtos on my little finger: now telling in the croſſe row the letters from A to F, I finde ſixe: this ſixe I ſubtract from 20. ſo reſt 14. which the day of October the Sunne entreth Scorpio.

Parergon ſecundum.

To know the Sunnes place in the Zodiacke vpon any day giuen.

FInde the Signe anſwering your moneth, and the word likewiſe, then to the day of the moneth put ten, and the number the firſt letter ſheweth in the croſſe row: if this be leſſe then 30. the number is the degrée of the Signe next before that, which the Sunne entreth in your moneth; if more, caſt away 30. and the reſidue is the degrée of the Signe entred in your moneth. Example, I would know where the Sunne is the *9.* of October, I finde in October he entreth Scorpio, and the word for it to be Fauſtos, whoſe firſt letter F is the ſixt in the croſſe row, I take ten and *6*, vz. *16.* which I put to, *9.* there is made 25. therefore I ſay the Sun is in the 25. degree of the Signe before Scorpio, which is Libra. If I would know for the 18. day, putting *16.* to 18. there would amount 34. from which abating 30. the 4. remaining ſheweth me, that the Sunne is in the 4. degrée of the Signe belonging to October, which is Scorpio.

Parergon tertium.

The place of the Sunne being giuen, to finde the day of the moneth.

TAke the day and moneth the Sun entreth the Signe giuen, the number of the degrées giuen put to the day, wherein the Sunne entreth the Signe, that product being leſſe than the dayes in your moneth, ſhew the day: but being more, caſt away the dayes of your moneth, the reſidue is the day of the moneth following. Example, I finde the Snnne in the 4. degrée of Scorpio, I would know what day of the moneth it is; I finde that the Sunne entreth Scorpio the 14. of October, I put 4. to 14. there amounteth 18. ſo I ſay it is the 18. day of October. Againe, let it be in the 25. of Libra, I finde that the Sunne entreth Libra 13. Septembris: I put 13. to 25. there amounteth 38. from which I take 30. the dayes of September, and there remaineth 8. the day of October. Theſe are but geſſes, as you may ſee much after the way commonly taught by the backe of the Aſtrolabe. Let him that deſireth exactnes, ſeeke the Sunnes place in ſome Ephemerides, or in the Regiment of the Sunne, publiſhed by E. W. painfully calculated vpon his owne diligent and exact obſeruations.

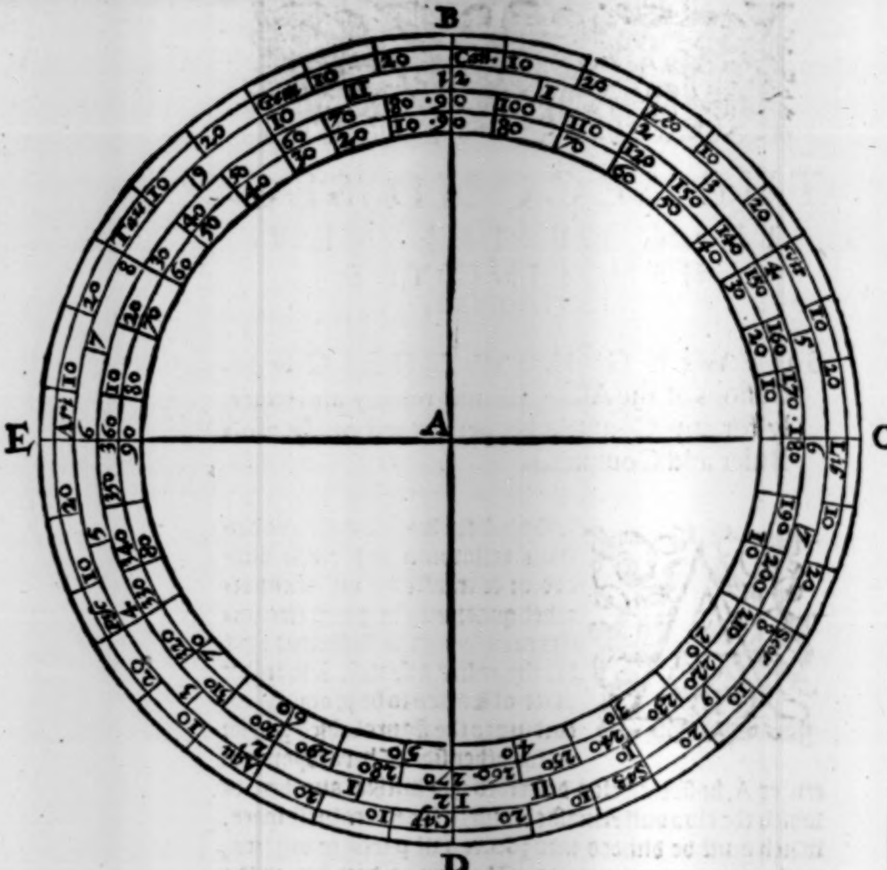
The end of the firſt Section.

THE

THE SECOND SECTION OF THE NEW HANDLING THE PLANISPHERE;

SHEWING HOW THE CONCLUſions of the Aſtrolabe may readily and exactly for any Countrie be performed onely with Ruler and Compaſſes.

Although for working the concluſions following any circle diuided, or to transferre out of any diuided quadrant, the giuen circumferences would be ſufficient: yet for the eaſier diſpatch, I would a plate of Latten to be prouided, according to the figure which you ſée on the other ſide. There, upon one center A, be ſixe circles deſcribed one within another, of which the two outtermoſt cōtaineth the narroweſt ſpace, which muſt be diuided into 360. equall parts or degrées, as the common manner is. At euery 30. degrées, in the ſpace contained under the ſecond and third circles, make diuiſions, and beginning at E writte Ari, or Aries: at the next, Tau, or Taurus, and ſo for the reſt of the 12. Signes; this circle ſhall be called the Zodiacke. The third ſpace, contained under the third and fourth circle, muſt bee di-



uided at euery 15. degrées: beginning at B you muſt ſet downe 12. at the next diuiſion toward C ſet downe 1. at the next 2. and at euery diuiſion the numbers in order, till comming to D, you are to ſet downe 12. againe: and ſo in the other ſemicircle D E B, ſet 1. at the diuiſion next D, at the ſecond 2. till comming to the next before B, you are to ſet downe 11: this fourth circle ſhall be called the houre circle. The fourth ſpace, contained vnder the fourth and fift circle, muſt be diuided at euery 10. degrees: at the firſt diuiſion from E towards B ſet 10. at the ſecond 20. and ſo encreaſing continually at euery diuiſion by 10. till you come againe to E, where you are to ſet downe 360. this circle ſhall be named the Equinoctiall. The ſpace contained vnder this and the firſt, or innermoſt circle, muſt from E by D vnto C, haue diuiſions at euery 20. degrees, and at euery diuiſion a number ſet encreaſing by 10. til you come to 90: in the quarters B C, B E, you muſt make diuiſions at euery 10. degrees: at the firſt, from B towards E, ſet 10, and likewiſe at the next vnto C towards B, at the next 20. and ſo in order, till comming to E and B, you are there to ſet 90: this inner circle ſhall be called the limbe. If you will ſet two ſights on the outter edge, ſo that the line, drawne from lope to lope, be parallel to the line ſubtending the arch B C, and hang a plummet from B, you may by your plate begin.

The firſt Concluſion.

To take the height of the Sunne, or any Starre, aboue the Horizon.

TUrning your plate towards the Sunne, lift it vp and downe, till his beames ſhine through both the lopes of your ſights, or (if it be a Starre) till you ſee it through them: the thréed ſheweth in the ſemicircle E D C, how many degrees the Sunne or Starre is aboue the Horizon.

The ſecond Concluſion.

To finde the diſtance of the Sunnes or any Starres Azimute, from any determinate poynt in the Horizon.

LEt your plate be fixed leuell with the Horizon, and direct E to any poynt: then a ruler being turned and lift vp by a ſteele or wier, ſtanding plumbe vpright from the center A, till you ſee the ſtarre, by the edge of it, or rather through two ſights ſet vpon the edge, or if it be the Sun, till his beames paſſe through the lopes, then without ſtirring the end next your eye bring it cloſe to the center, the edge ſheweth in the Equinoctiall the diſtance of the Azimute from the poynt reſpected by E. The Azimute is ſayd ſimply without adition to bee giuen, when his diſtance from the Meridians North end is giuen.

The third Concluſion.

From a point giuen in the circumference of a circle, at any ſide aſſigned, to applie or ſubtend a diſtance or a right line not greater than the Diameter.

LEt the poynt giuen be C, from which vpon the ſide towards D, I am to applie a line equall to A Q, draw the Diameter C A E: now if the line A Q be equall to the Diameter, I haue done that which is required: but being leſſe, I take the diſtance A Q with my Compaſſe, and ſetting one foote in C, with the other I marke Q in the limbe, and ſo vnder the circumference C Q, I haue ſubtended a diſtance equall to A Q, which was required.

The fourth Concluſion.

From a point giuen in any circles circumference, to take at any ſide aſſigned, an arch equall to any arch giuen in the ſame, or any equall circle.

From the poynt giuen C, draw the Diameter C A E: now if the arch giuen be a ſemicircle, the circumferẽce C D E, taken at the ſide aſſigned D, is the arch deſired: but if it be leſſer, as F G, I take the diſtance F G, and ſetting one foote of the Compaſſe in C, with the other towards D, I marke 3 in the limbe, the circumference 3 C is that, which is deſired: but if it be greater than a ſemicircle, as 6 G, I take in like manner with my Compaſſe the diſtance 6 G, and ſetting one foote in C, on the other ſide towards B, not on that which was aſſigned towards D, I marke in the limbe with the other foote L, the circumference C D L is that, which is required.

The fift Concluſion.

The heights or Almicanters, together with the diſtance betweene the Azimutes of any two Stars giuen, or taken by obſeruation, to finde the diſtance one from another.

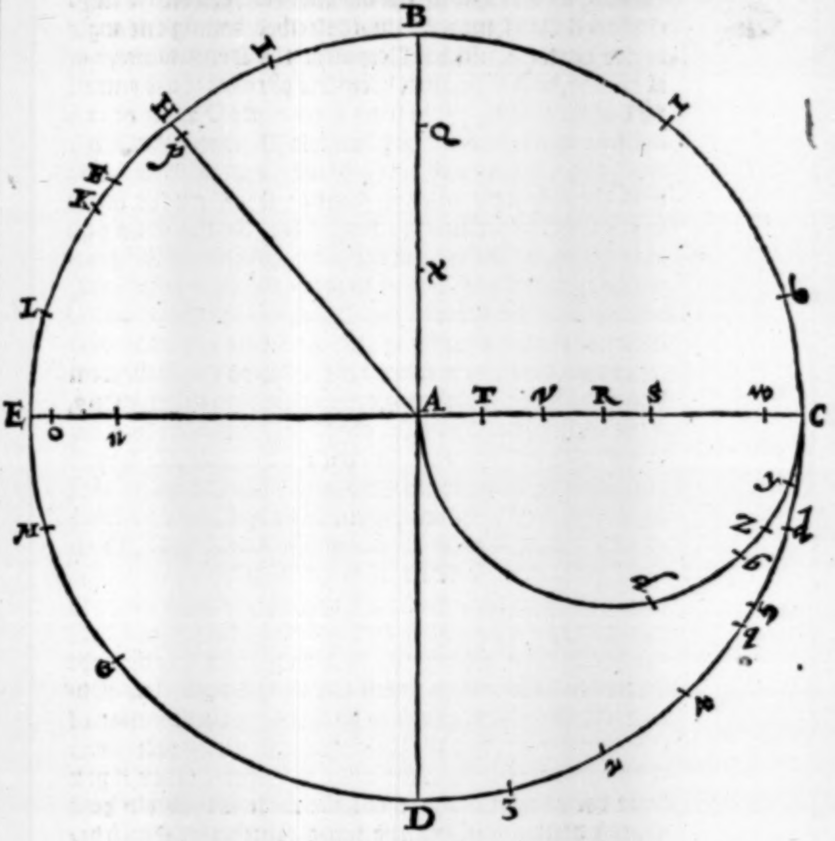
Vpon the center A deſcribe a circle B C D E, and let the Diameters B D, C E, bee perpendiculars one to another. This conſtruction ſhall bee alwaies aſſumed hereafter without further expreſſing: from E to H reckon the diſtance of the Azimutes, and draw the line A H: then taking the circumference E F, equall to the greateſt altitude, and making E G equall to it, vpon F and G laying a ruler, it will cut A E in N: againe, taking H I equall to the other altitude, make H K equall to it, a ruler layd on I and K, will cut A H in P, take the diſtance N P, and ſetting one foote of the Compaſſe in A, with the other in A B mark Q: againe, taking the diſtance F N, and ſetting one foote in A, take the line A S: againe make the line S T equall to the diſtance P I, opening your Compaſſe to the diſtance T Q, ſetting one foote in C, with the other in the limbe mark 4, the circumference C 4 is the diſtance ſought. This conſtruction is generall, but in ſome caſes may be abridged: for if the Altitudes were equall, it ſhould ſuffice to applie the diſtance N P in the limbe without any more adoe: if both were in one Azimute betweene the Horizon and the Zenith, as E F being the greater, and F L the leſſer, the diſtance ſhould be L E: but if the Zenith were betweene the height, whereof E M were the one, laying a ruler on M and A, it would cut the limbes beyond A in 6. then toward B, taking the other height 6.1. the diſtance ſhall be E B, 1.

The ſixt Concluſion.

In any Countrie vnknowne to finde the Diameter of the Parallel of the Sunne, or any vnknowne Starre.

Three times in one day, or for any Starre in the night, take the height and diſtance of the Azimute from any certaine poynt, whereby you may haue the diſtance of euery Azimute from other, by the former concluſion: take the diſtance of the poynts obſerued one from another, which let bee C 6. 6 B and B K of three lines equall to the chords, of thoſe circumferences, make a triangle C B A, and about it deſcribe a circle A B C, whoſe Diameter A C is the Parallels Diameter.

The



The ſeuenth Concluſion.

The Diameter of the Sunnes, or any Starres parallel being giuen, to finde the declination.

FRom C on either ſide applie a diſtance equall to A C, as C 1, C 2, vpon 1 & 2 a ruler layd, will cut A C in R:

vpon R, as a center at the diſtance A R, deſcribe a ſemicircle A B C (a ſemicircle thus deſcribed, hauing one angle in the center A, and his Diameter the Semidiameter of the limbe, as A C is, ſhall hereafter be called the Synicall arch of the limbe). Now from C towards D apply at 12 a diſtance equall to A C; the Parallels Diameter giuen, vpon C and 2, laying a ruler it will cut the Semicircle A B C in D, then laying a ruler on A and D, it will cut the limbe in 5. 5 C is the declination ſought for. In the Sun you may know, by the time of the yeere, whether it be Northerly or Southerly, and to what quadrant it belongeth, ſauing when he is neere the Tropickes, or Equinoctiall ſections: for diſtinguiſhing thereof, make your obſeruations two, or three, or foure ſundrie dayes: then the Sun being about the Tropickes, comparing two obſeruations, if the declination encreaſe, the firſt obſeruation was before it came to the Tropicke: but if it decreaſe, the ſecond was after it came to the Tropicke, the Tropicke will ſhew North and South, from Aries by Cancer to Libra North, from thence by Capricornus to Aries South. About the Equinoctiall ſections, if the declination encreaſe, the Sunne is paſt the ſection: if it decreaſe, it is not come to it, and ſo you may know certainly vnto which quadrant the declination belongeth. You may finde whether the Starre you obſerue, declineth North or South, thus: Obſerue two Starres, of which by marking the ſituation of Charles wayne, and the Pole ſtarre, you may determine the more Southerly, or the more Northerly: then if you finde their declinations equall, the more Southerly hath South declination, and the more Northerly, North declination: but if they be vnequall, the more Southerly, being leſſe, it declineth Southward: but if it haue the greater declination, the more Northerly declineth North, which is to be vnderſtood of obſeruations taken on this Northſide of the Equinoctiall: but you may make this doctrine generall, thus: If that which is neereſt the hidden

den pole be leſſe, it declineth toward that pole: if greater, then that, which is neerer the apparant pole, declineth toward the apparant pole. This diſtiction ſhall not alwaies be preciſely obſerued hereafter.

The eight Concluſion.

The declination of the Sunne, or any Starre being giuen, together with the Azimute and anie height, to finde the Meridian height.

LEt the circumferences E F, C G, be made either of them equall to the height giuen, and laying a ruler on F and G, it will cut A B in P: make the circumference E X equall to E F, and laying a ruler on P and X, it will cut A E in Y: vpon Y, as a center, at the diſtance Y A, deſcribe a ſemicircle R V A (a ſemicircle thus deſcribed, hauing one angle in the center A, and the Diameter equall to the ſemidiameter of another circle, as R A equall to F P, which is the ſemidiameter of the circle, whoſe Diameter is the diſtance F G) this ſemicircle ſhall be called the Synicall arch of that line, or diſtance, as R V A is the Synical arch of the diſtance F G. Let the diſtance of the Azimute from the Eaſt, and that in this figure Southward, be the circumference E W: vpon A and W, laying a ruler, it will cut the ſemicircle R V A in V, take the diſtance R V, and ſetting one foote of your Compaſſe in P, with the other in the line P F, marke a poynt O. Now let K L be the Diameter of the Sunnes parallel, and diuide K L ſo in O, as the greater ſegment O L may be to O G, the greater ſegment of F G, as F O, the leſſer ſegment of F G, is to the leſſer ſegment K O (how this may be done ſhall be taught hereafter:) then opening your Compaſſe to the length of the ſegment lying toward the quadrant E F B, as namely to O K, ſet one foote in O, and with the other marke in the

the quadrant E F B the poynt K, the circumference E K is the Meridian height.

A Lemma.

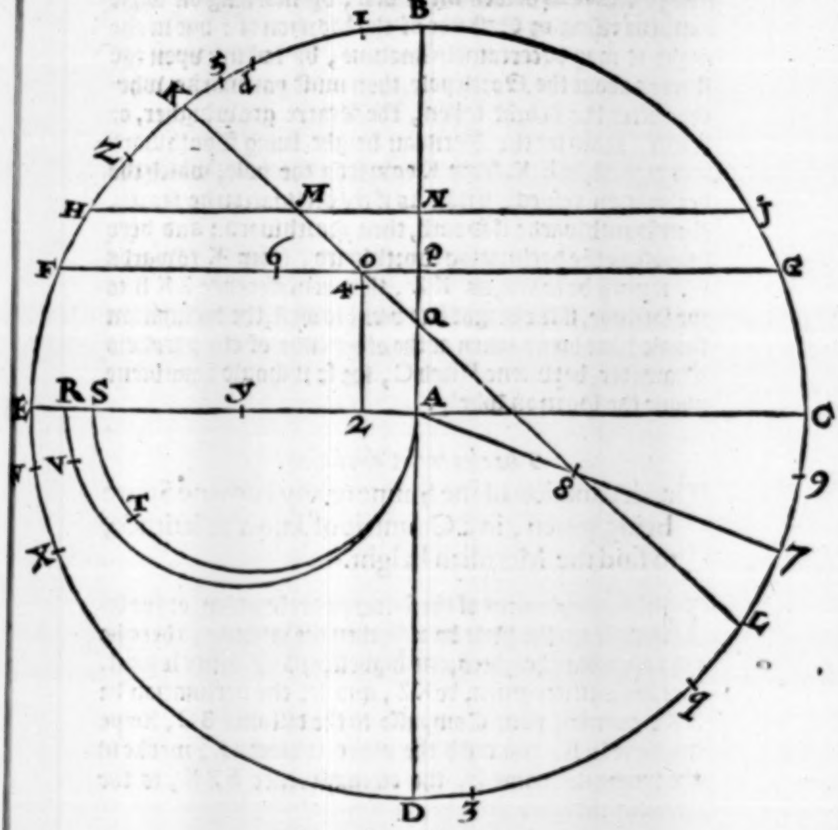
Betwéene F O and O G, by 13. P. 6. take a meane proportionall H N, and to that meane proportional giuen, in K L finde the two extremes, K O, O L, by the addition of Peletarius to 13. P. 6. but in the Engliſh Euclyde the figure is drawne wrong, & the demonſtration diſtorted: you may helpe your ſelfe in the ſame author, where 17. p. 10. you haue out of Campane the ſame matter truly propounded.

The ninth Concluſion.

In any Countrie vnknowne, two different heights with the Azimutes of the Sunne, or any knowne Star being giuen, to finde their Meridian height, and declination.

Let the two heights giuē be E F, and E H, make C G equal to E F, and C I equall to E H, draw the lines F G, and A I, cutting A B in the poynts P & N: let the ſemicircle R V A be the Synicall arch to F G, and S T A, the Synical arch to H I. Moreouer, let E W be the diſtance of the Azimute, belonging to the height E F, from the Eaſt South, and E X, the diſtance of the Azimute, belonging to the height E H: likewiſe from the Eaſt South, a ruler layd on A and W, will cut the ſemicircle R V A in V: take the diſtance R V, and ſetting one fóote in P, with the other in P F marke O: againe, laying a ruler on X and A, it will cut the ſemicircle S T A in T: take the diſtance S T, and ſetting one fóote in N, with the other in the line N H, marke a poynt M: vpon M and O laying a ruler, draw the line K M O L, which is the Diameter for the parallel of declination, whereby you may know the declination, and E K is the Meridian height.

The



The tenth Concluſion.

The Meridian height & declination of the Sunne, or any Starre being giuen, to finde the latitude.

FIrſt you muſt know whether the height be Northerly or Southerly, which Nonnius thinketh the magneticall Index, or Compaſſe will ſhewe readily, and exactly enough:

nough: Clauius determineth of it, by marking on what hand the riſing or Eaſt ſide of the Horizon is: but in the night it may be certainely knowne, by looking vpon the ſtarres about the North pole, then muſt you marke, whether after the height taken, the Starre grow higher, or lower. Now let the Meridian height being Southward and higheſt, be E K, from K towards the pole, which the declination reſpecteth not, as if the declination be North, then Southward: if South, then Northward: and here ſuppoſing the declination Northward, from K towards E, it muſt be taken, as K Z, the circumference Z K B is the latitude, if the height had beene loweſt, the declination ſhould haue beene taken at the other ende of the parallels Diameter, betweene B and C, for ſo it ſhould haue beene aboue the Horizon wholy.

The eleuenth Concluſion.

The declination of the Sunne or any knowne Starre being giuen, in a Countrie of knowne latitude, to find the Meridian height.

If the complement of the Starres declination, or the diſtance from the Pole be leſſe then the latitude, there be two Meridian heightes, one higheſt, and the other loweſt. Let the latitude giuen, be K Z, and let the declination be Z K, opening your Compaſſe to the diſtance B C, keepe one foote in B, and with the other towards K, marke in the lymbe the point E, the circumference E Z K, is the Meridian height.

The twelfth Concluſion.

The Meridian height of the Sunne, or any Starre being giuen, in a Countrie of knowne latitude, to finde the Declination.

Let E K be the Meridian height, opening your Compaſſe to the latitude giuen, ſet one foote in B, and with the other from the pole, marke in the lymbe the point Z: Z K is the declination ſought for, taking denomination of that Pole, betweene which, and Z, it is placed.

The thirteenth Concluſion.

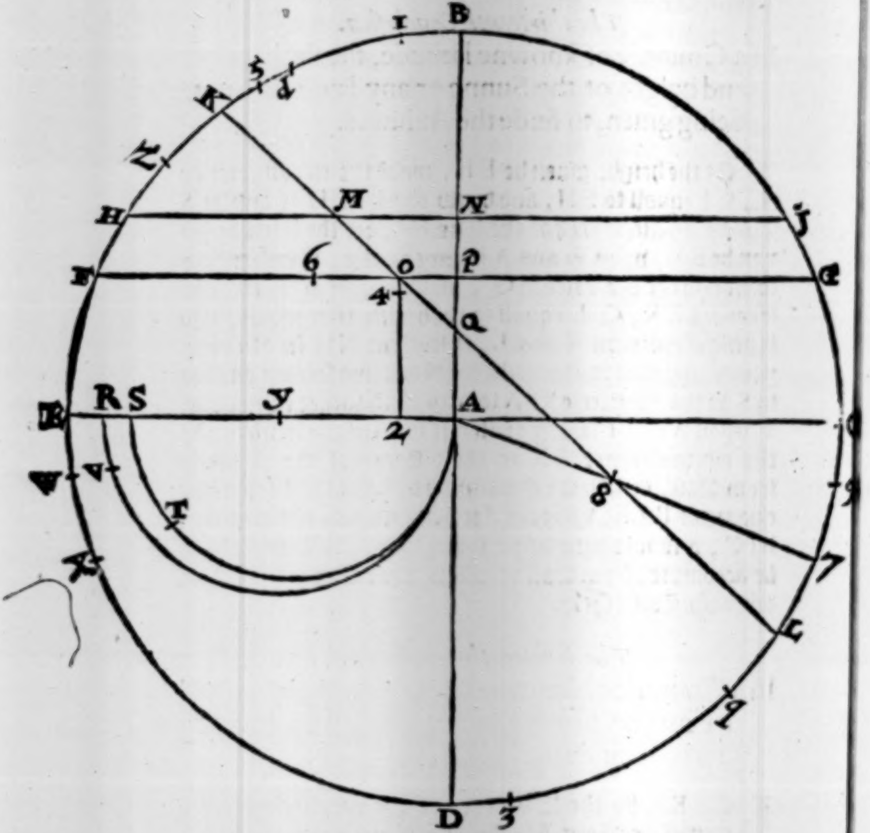
In a Countrie of knowne latitude, the declination, and height of the Sunne or any knowne Starre being giuen, to finde the Azimute.

Let the height giuen be E H, make the circumference C I equall to E H, and draw the lyne H I, and let S T A be Spuicall arch of the lyne H I, let the latitude giuen be B Z, vpon Z and A laying a ruler, it will cut the lymbe on the other ſide in Q, make eyther of the circumferences Z K, Q L equall to the declination giuen, and laying a ruler on K and L, it will cut N H in M: with your compaſſe take the diſtance N M, and ſetting one foot in S, in the ſemicircle S T A take with the other foot a point T, vpon A and T laying a ruler, it will cut the lymbe in X: the circumference E X is the diſtance of the Azimute from Eaſt, or Weſt: Southward, becauſe M fell in the quadrant B Z E, whereas if it had fallen in the quadrant B I C, it ſhould haue beene Northward, whether it be to be accompted from Eaſt or Weſt, the riſing in height, or decreaſing will ſhew.

The fourteenth Concluſion.

In a Countrie of knowne latitude, the Azimute and declination of the Sunne, or any Starre beeing giuen, to finde the height.

Let K L be the Diameter of the parallell of declination, cutting A B the axis of the Horizon in Q, and let B D, be equall to the Azimutes diſtance from the Eaſt, or Weſt towards the South taken in the quadrant B E, if it were Northward, it were to be taken in the quadrant B C: betweene D and B take any point 1, and make the circumference D 3 equall to 1 B, laying a ruler vpon 3 and 1, draw the line 2 O, then making A P equall



to 2 O, vpon O and P, laying a ruler, draw the line P O F, a ruler layd on A and D, will cut O 2 4: in P F take a line P 6, equall to the diſtance A 4, then laying a ruler

vpon Q and 6, it will cut the lymbe in H, the circumference EFH is the height deſired. In ſome caſes this conſtruction will not be contayned within the lymbe, but it is generally true.

The fifteenth Concluſion.

In a Countrie of knowen latitude the Azimute, and height of the Sunne, or any Starre being giuen, to finde the declination.

LEt BZ be the latitude giuen, and let the altitude be EH, make CI equall to EH, and drawe the line HI, cutting AB, in N: let the diſtance of the Azimute from the Eaſt be EX; and let STA be the Synicall arche of HI: now laying a ruler on A and X, it will cut STA in T, take the diſtance ST, and ſetting one foote in N, with the other in NH, becauſe the Azimute is Southward (otherwiſe in NI) take a point M, vpon M and A laying a ruler it will cut the limbe in 5, make Q7 equall to Z5, & draw the line A7, make A8, equal to AM, vpon M and 8, laying a ruler, draw the lyne KM8L, the circumference ZK, or QL, is the declination ſought.

The ſixteenth Concluſion.

The Sunnes declination being giuen, to finde his place in the Zodiacke.

LEt EH be the Sunnes greateſt declination, videl. as I ſaid in the firſt ſection, to be receiued vpon their credite, which by obſeruation made with large inſtruments, affirme it in this our age to be 23. degrées, 30. minutes: draw the line AH, and let eyther of the circumferences, EF, CG, be equall to the declination giuen, vpon F and G laying a ruler, it will cut AH in K: in EMA the Synicall arche of the lymbe, apply from E at M a diſtance equall to AK, vpon M and A lay a ruler, which will cut the lymbe in O, a circumference taken in the quadrante, to which the declination belongeth, from the next Equinoctiall ſection, equall to E O, as E O in the quadrante D E, ſheweth the place of the Sunne, accounting from E, the beginning of Aries by B and C, to O.

The ſeuenteenth Concluſion.

Another way to finde the Sunnes place by his declination giuen.

VPon I, and H, the Sunnes greateſt declination reckoned from E, and C, lay a ruler, which will cut the line A B in P, vpon A as a center, at the diſtance A P, deſcribe a circle Q P R: now let either of the circumferences E F, C G be equall to the declination giuen, vpon F and G lay a ruler, which will cut the circle Q A R in S, and likewiſe on the other ſide in W, but imagining the declination to appertaine to the Quadrant E H B, take S, the point in it, and vpon S and A laying a ruler, it will cut the lymbe in T, reckoning from E the beginning of Aries to T, you haue the Sunnes place you ſought for.

The eighteenth Concluſion.

The Sunnes place in the Zodiacke being giuen, to finde his declination.

FRom E towardes D take a circumference E O equall to the Sunnes diſtance from the Equinoctiall ſection, that is neareſt to his place, and let E M A be the Synicall arche of the limbe, E H, C I equall to the Sunnes greateſt declination, and drawe the lines H A, A I, then laying a ruler on A, and O, it will cut E M A in M: make A K equall to the diſtance E M, and A V equall to A K, then laying a ruler on K and V, it will cut the limbe in F, and G, eyther of the Circumferences E F, C G, are the declination ſought for.

The nineteenth Concluſion.

Another way to finde the Sunnes declination by his place giuen.

Vpon T the Sunnes place, and A lay a ruler, which will cut the circle QPR in S: make the circumference RW, equall to QS, and laying a ruler on S and W, it will cut the limbe in F and G, either of the circumferences EF, or CG is the declination ſought for.

The twentith Concluſion.

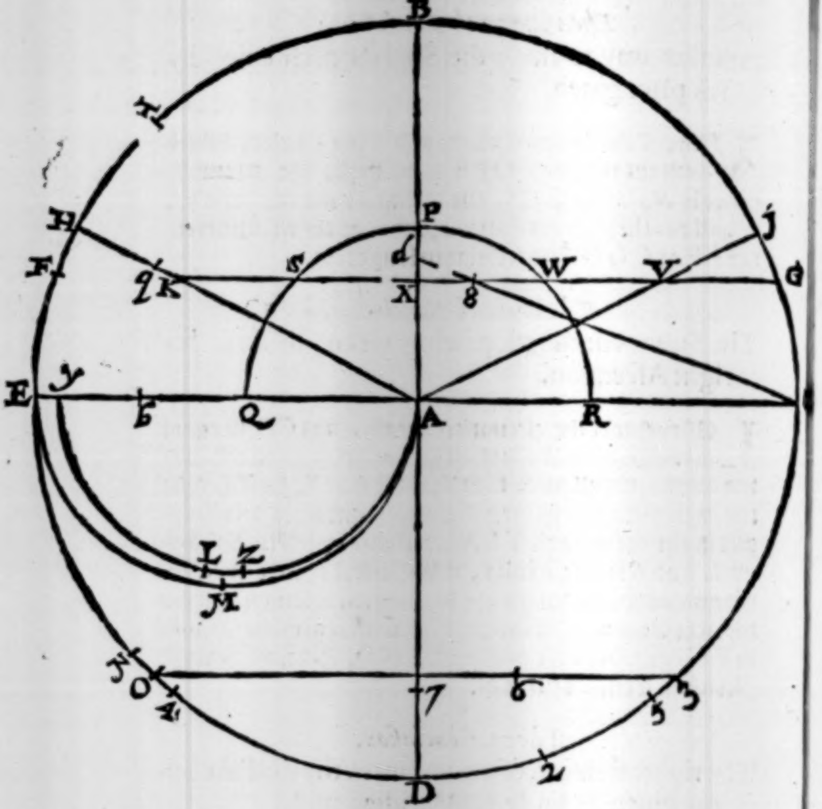
The Sunnes declination being giuen, to finde his right Aſcenſion.

Let eyther of the circumferences EF, and CG, be equal to the Sunnes declination giuen, vpon G, and F laying a ruler, it will cut AH in K, and BA in X, let YLA be the Synicall arche of the diſtance FG, and from Y to L applie in the Semicircle YLA, a diſtance equall to XK; vpon L and A laying a ruler, it will cut the limbe in N. In the quadrant, to which the declination belongeth, from the next Equinoctiall ſection, a circumference taken equall to EN, as EN in the quadrant END, ſheweth the right aſcenſion from E by B to N.

The 21. Concluſion.

The right aſcenſion of any point in the Zodiake being giuen, to finde the Meridian angle.

Let EO be equall to the diſtance of the right aſcenſion frō the neareſt Equinoctial ſection, vpon A & O a ruler laid will cut EMA the Synical arche of the limbe in M, in the lines HA, AI take AK, and AV equall to the diſtance EM, vpon KV, laying a ruler, it wil cut AB in X: in YLA the Synicall arch of the diſtance FG applie at Z, from A



a diſtance equall to XV, a ruler laid on A and Z, cutteth the limbe in 4, the circumference E 4 is the Meridian angle.

The

The 22. Concluſion.

The right aſcenſion of the Sunne being giuen, to finde his place in the Zodiacke.

LEt E O be equall to the right aſcenſions diſtance from the neareſt Equinoctiall ſection, and make D 3 equall to D O and draw the line O 3, let the Meridian angle taken by the former concluſion be E 4, and make D 5 equall to D 4 a ruler laid vpon the points 4 and 5 will cut A D in 7, open your compaſſe to the diſtance A 7 and keeping one foot in A, with the other towards 3, in the line O 3, marke a point 6, a ruler laid on A and 6, cutteth the lymbe in 2, the circumference C 2 is equall to the diſtance of the Sunnes place from the Equinoctiall ſection, in the quadrant, wherein the right aſcenſion was.

The 23. Concluſion.

The Sunnes right aſcenſion being giuen, to finde his declination.

FRom D and B towardes E, take circumferences D O, B T equall to the diſtance of the right aſcenſion from the neareſt Equinoctiall ſection, & laying a ruler on O and T, it will cut the lines AE, AH in the points B & Q: in A B take A D, equall to the diſtance B Q, and drawe the line D C, in it take a line C 8, equall to C A, and then taking the diſtance A8, ſet one foote of your compaſſe in E, and with the other in the quadrant E B, marke a point F, the circumference E F, is the declination ſought for.

The 24. Concluſion.

The declination of any ſtarre being giuen, with his latitude, which neuer altereth, to finde his longitude or place in the Zodiacke.

LEt L be the pole of the Zodiacke, B the pole of the worlde, and make the circumferences L H, L I equall to the complement of the latitude giuen, that is, let them be equall to that portion of a quadrant, whereby it exceedeth the latitude, draw the line H I. Againe let either of the circumferences E F, C G be equall to the declination giuen, a ruler laid vpon F and G, will cut H I in K: againe a ruler laid on A and L, will cut it in M: with your compaſſe take the diſtance M K, & in the ſemicircle 6 N A, which is the Synicall arch for the line H I, from 6 apply at N a diſtance equal to M K, a ruler laid vpon yͤ points A N, will cut the limbe in O: a diſtance equal to E O, applyed in the quadrant C D, to which I ſuppoſe the declination belongeth, from C the Equinoctiall ſection, vnto P, ſheweth in the Zodiacke from E by B to P the place of the ſtarre.

The 25. Concluſion.

The declination of any ſtarre being giuen, with his latitude, which neuer altereth, to finde the right Aſcenſion thereof.

As before let L be the pole of the Zodiacke, B, the pole of the world, L I, L H, the complements of the ſtarres latitude, E F, CG, equall to the declination, draw the line H I, and lay a ruler on F and G, which will cut A B in Q, and H I in K; let the ſemicircle A R S be the Sinicall arch for the diſtance F G, and from S in the ſemicircle A R S, applie at R a diſtance equall to the diſtance Q K, a ruler laid on R & A, will cut the limbe in T, the diſtance, C T, in the quadrant, to which the declination belongeth, applied from the Equinoctiall ſection, ſheweth in the Equinoctiall the right aſcenſion ſought for.

The 26. Concluſion.

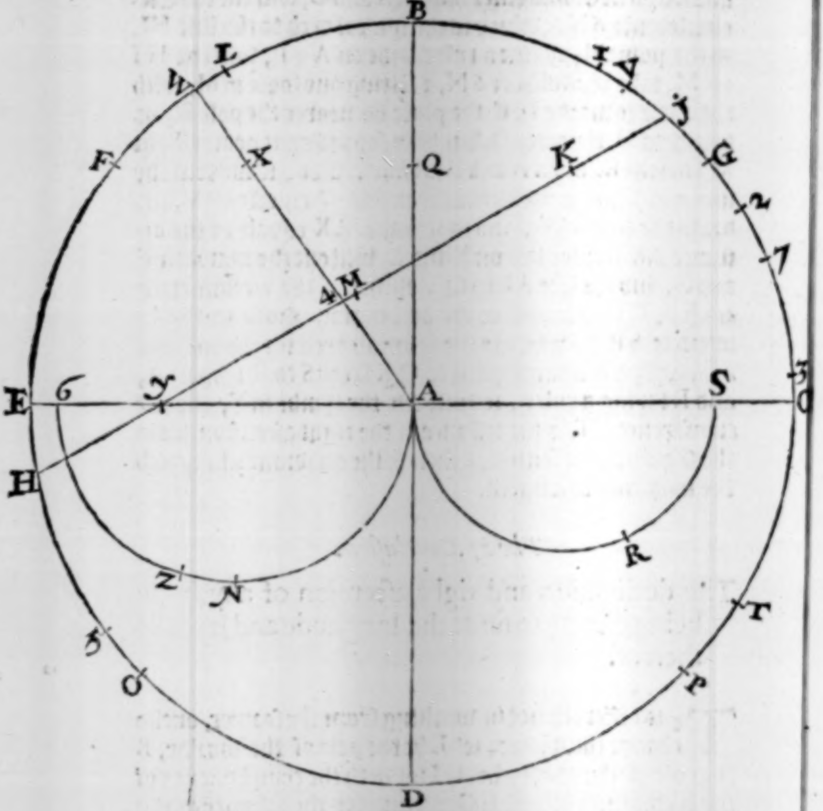
The longitude and latitude of any ſtarre being giuen, to finde the declination and right Aſcenſion thereof.

Let the poles & latitude be as before, & let E O be equal to the diſtance of the ſtars place from the neareſt Equinoctiall ſection: a ruler laid on A and O, will cut the Circumference 6 NA, which is the ſynical arch to the line HI, in the point N; againe a ruler laide on A & I, will cut H I in M, take the diſtance 6 N, & ſetting one foote in M, with the other towards I, if the place be nearer the pole B, or towards H, if nearer D, but here ſuppoſing it nearer B, in M I marke K, vpon A and K laying a ruler, it will cut the limbe in V, make the circumference B W equal to B V, and draw the line A W, and in it make AX equall to the diſtance AK, a ruler laid on X and K, will cut the lymbe in F and G, and the line A B in Q, eyther of the circumferences EF, CG is equall to the declination. Now in the ſemicircle SRA, which is the Sinicall arch for the diſtance FG, apply a diſtance equall to QK from S to R: vpon A, and R laying a ruler, it will cut the lymbe in T, the circumference CT, is the diſtance of the right aſcenſion, from the Equinoctiall ſection, taken in the quadrant, to which the longitude belongeth.

The 27. Concluſion.

The declination and right aſcenſion of any ſtarre being giuen, to finde the longitude and latitude thereof.

This differeth not in working from the former, onelie change the names, let L be the pole of the worlde, B the pole of the Zodiacke, H I ioyneth the complements of the declination giuen, E O is equall to the diſtance of the right aſcenſion, from the neareſt Equinoctiall ſection, 6 N A the Synicall arch for H I, is cut in N by a ruler laid on O and A, make M K equall to 6 N, vpon A and K a ruler laid cutteth the limbe in V, ẏ circumferences B V, B W being equall, and the line A W drawen, A X muſt be made equall to A K, a ruler lying on X and K cutteth the limbe in F and G, ſo either of the circumferences E F, C G be e-



quall to the latitude ſought for. In the Synicall arch of F G, which is A R S, a diſtance equall to M K applyed from S to R, and then a ruler laid on A and R, cutteth the limbe in T, ſo is C T the diſtance of the longitude, from the neareſt Equinoctiall ſection taken in the quadrant, to which the right aſcenſion belongeth.

The 28. Concluſion.

The longitudes and latitudes of any two ſtarres, or any two places in the earth being giuen, to finde the diſtance of the one from the other.

If they be both on one ſide of the Equinoctiall, or of the Eclipticke what caſe ſoeuer fall out, you ſhall take their latitudes, as heights aboue the Horizon, and the difference of their longitudes, as the diſtance of their Azimutes; by which working, after the 5. Concluſion, you ſhall finde their diſtance: but if one be on the one ſide of the Equinoctiall, and the other on the other, or, of the Eclipticke, then if they differ not in longitude, from E towardes B, take one latitude E L, and make L K equall to the other latitude, the circumference EK in the Equinoctiall ſheweth their diſtance. If they differ in longitude a whole ſemicircle, from E towards D take E M one latitude, and laying a ruler on M and A, it will cut the limbe on the other ſide in *6*, take *6* 1, the other latitude, and from E to 1, in the Equinoctiall, you ſhall finde the diſtance: but let the difference of the longitudes be E H; and drawe the line A H, let the circumference F E be equall to the greater latitude, H I to the leſſe, then making E G equall to E F, and H K equall to H I, vpon F and G a ruler laide, will cut A E in N, likewiſe laide on I K, it will cut H A in P. In the line A B take A Q equall to the diſtance N P, and in A C make A S equall to F N, and S W equall to I P, in the quadrant C D from C vnto 3 applie a diſtance equall to Q W, the Circumference C 3, is the diſtance ſought for.

The 29. Concluſion.

The Latitudes and diſtance of any two Starres, or any two places in the Earth being giuen, to finde the difference of their Longitudes.

Let the places firſt be on the one ſide of the eclipticke, or the Equinoctiall, and let the diſtance giuen be C 4, let the greater Latitude be E F, the leſſer E L; make the Circumferences E G equall to E F, and E M equall to E L, then laying a ruler on F and G, it will cut A E in N, and laide vpon L and M, it will cut it in O, make A S equall to N F, and S V equall to L O, then opening your compaſſe to the diſtance C 4, ſet one foote in V, and with the other marke Q in the line A B, taking the diſtance A Q, ſet one foote in N, and with the other deſcribe an arch at P, then opening your compaſſe to the diſtance A O, and keeping one foote in A, with the other croſſe the arche at P, a ruler laide on A and P, cutteth the limbe in H, the Circumference E H is the difference of their Longitudes: when the Circumferences meete in the line A, they differ not in Longitude, otherwiſe the conſtruction is generall in this caſe. But if one be on the one ſide, and the other on the other, then muſt you make S W equall to L O, and opening your compaſſe to the diſtance giuen, which ſuppoſe were C 3, ſet one foote in W, and with the other, in the line A B, marke the poynt Q, and then on N, as a Center at the diſtance A Q, deſcribe an arch at P, which being croſſed with another arch, deſcribed vpon the Center A, at the diſtance A O, a line drawne from A by P to H, ſheweth E H, the difference of their Longitudes.

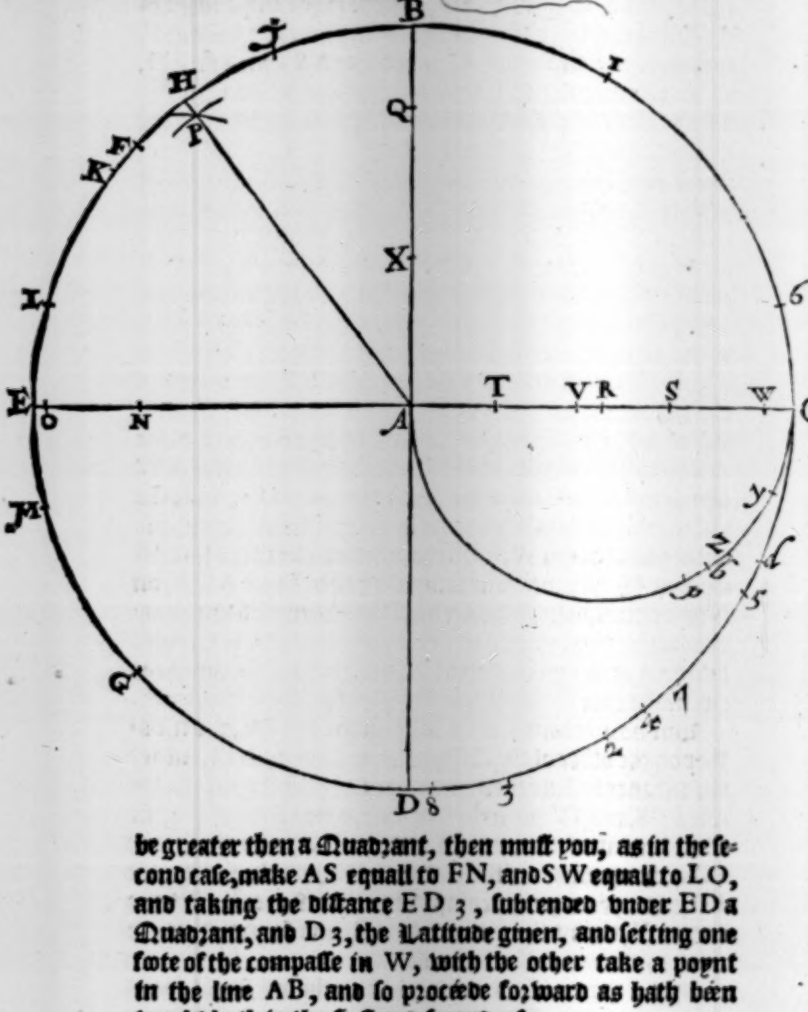
The 30. Concluſion.

The Longitudes and Latitudes of any two Starres, or any two places in the Earth being giuen, to finde the angle of Poſition, or the bearing of the one from the other.

By the Longitudes and Latitudes you may finde the diſtance, and firſt let both the Latitudes be on the one ſide of the Eclipticke, or the Equinoctiall, & their diſtance leſſe then a Quadrant, as B L, and E F the Latitude of the place from which the other beareth; the complement of the other place whoſe poſition is ſought C 4, make E G equall to E F, and E M equall to E L, which is the complement of the diſtance B L, that is giuen: laying a ruler on G and F, it will cut A E in N, in A C take a line A S equall to F N, then laying a ruler on L and M, it will cut A E in O, make S V equall to L O. Now take the diſtance C 4, which is the complement of the Latitude belonging to the other place, and ſetting one foote in V, with the other marke in A B, a poynte Q, taking yͤ diſtance A Q, ſet one foote of your compaſſe in N, and with the other make an arch at P, then vpon A as a center, at the diſtance A O, deſcribe an arch at P, croſſing the former, a ruler layde on A and P, will cut the limbe in H, and ſo E H is the angle of poſition ſought for. But if the diſtance be greater then a Quadrant, as for example D L, then making E M equall to L E, the exceſſe of the diſtance aboue a Quadrant, vpon L and M lay a ruler, which will cut A E in O, then hauing taken in A C, a line A S equall to the diſtance F N, take alſo in S C a line S W equall to L O, and the other Latitude being D 3, take the diſtance C 3, ſubtended vnder the complement thereof, and ſetting one foote in W, with the other marke in the line A B a poynt Q, opening your compaſſe to yͤ diſtance A Q, vpon N as a center, deſcribe an arch at P, which croſſed with another arch deſcribed on yͤ center A, at yͤ diſtance A O, a ruler laid on A, and the croſſing at P, cutteth from the limbe the circumference E H, which is yͤ angle of poſition ſought for.

But now let one Latitude be on the one ſide, and the other on the other of the Eclipticke, or Equinoctiall, and let the diſtance be leſſe then a quadrant, thẽ muſt you take the lines A S, and S V, as in the firſt caſe, but in ſteed of C 4, the complement of the other Latitude D 4, you muſt take E D 4, compounded of the Latitude D 4, and the Quadrant E D, and opening your compaſſe to the diſtance E 4, ſet one foote in V, then take a poynt in A B, and ſo proſecute the conſtruction as in the firſt caſe.

But if the Latitudes being one on the one ſide, and the other on yͤ other of the eclipticke, or equinoctiall, yͤ diſtance



be greater then a Quadrant, then muſt you, as in the ſecond caſe, make AS equall to FN, and SW equall to LO, and taking the diſtance ED 3, ſubtended vnder ED a Quadrant, and D 3, the Latitude giuen, and ſetting one foote of the compaſſe in W, with the other take a poynt in the line AB, and ſo procéede forward as hath béen taught both in the firſt and ſecond caſe.

The

The 31. Concluſion.

The Latitude of one Starre, or one place in the Earth being giuen, with the diſtance, and angle of poſition, or bearing towards another, to finde the Latitude of this other, and the difference of their Longitudes.

Let the angle of Poſition be equall to the Circumference H E, and let the Latitude giuen be E F, and the diſtance being leſſe then a Quadrant, let his complement be H I, make the Circumference E G equall to E F, and H K equall to H I, a ruler laide on F, and G, will cut A E in N: againe laying a ruler on I and K, it will cut A H in in P, in the line A B take A Q, equall to the diſtance N P, and in A C take a diſtance equall to Q V, which being leſſe then a Quadrant, is the Latitude of the other Starre or place, and on the ſame ſide of the Eclipticke, or Equinoctiall that the former Latitude is: but if it had been greater, then a Quadrant as E D 4, then ſhould D 4 the exceſſe aboue a Quadrant, be the Latitude ſought for, and on the other ſide of the Eclipticke, or Equinoctiall: thus hauing the two Latitudes by them and the diſtance giuen, you may finde the difference of their Longitudes.

But if the diſtance be greater then a Quadrant, as 6 B H is, then muſt you take H I, the exceſſe of it, aboue the Quadrant I B 6, and making H K equall to H I, and E G equall to F E, the Latitude giuen, lay a ruler on F G, which will cut the line A E in N, and on I K, which will cut A H in P, then make A Q equall to N P, and A S equall to F N, and S W equall to I P, then in the lymbe from C, applie at 3 a diſtance equall to W Q, the Circumference C 3, being leſſe then a Quadrant, the Complement thereof D 3, is the Latitude ſought for: but if it be greater then a Quadrant, as E D 3, then is D 3 the exceſſe of it aboue a

Quadrant, the Latitude ſought, but on the ſide contrarie to the Latitude giuen, as it was on the ſame ſide being leſſe then a Quadrant.

Adnotandum.

Ptolomey in the firſt booke of his Geographie, Chap. 3. promiſeth with his Meteoroſcopium, by the Latitudes of two places giuen, and the angle of Poſition to finde the difference of their Longitude, which as Nonnius hath truly noted, cannot poſſibly by any inſtrument be performed, no nor by any tables, though Regiomontanus Tabul. prim. mob. Prop. 46. hath vndertaken it: this 31. Concluſion expreſſeth a generall truth, and Regiomontanus in his treatiſe de Meteoroſc. quite digreſſing from Ptolomey, hath in like manner expreſſed it.

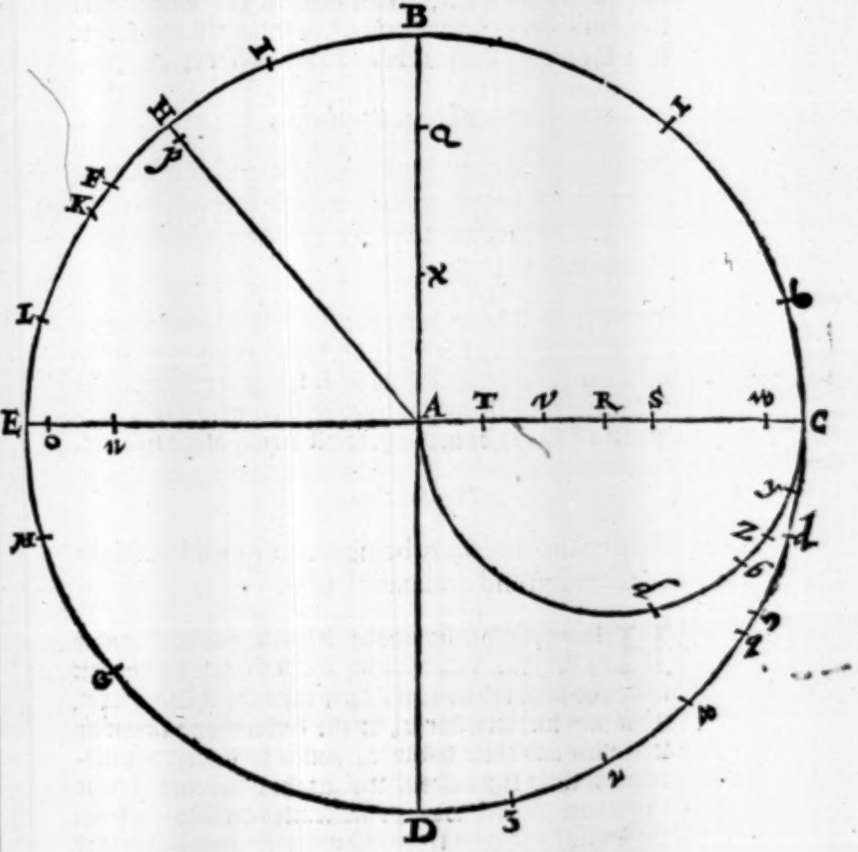
A Caution.

In theſe foure laſt Concluſions, following the conſtruction here ſet downe, the circle will not be ſufficient to containe the lines required, which you may helpe by the Synicall arch of the lymbe, applying your lines in the limbe from the concourſe thereof and the Synicall arch, it would be too tedious to exemplifie all particulars, therefore for your better vnderſtanding I will onely ſet down for.

The 32. Concluſion.

Another way to finde the diſtance of two Starres, or places in the Earth, hauing their Latitudes, and the difference of their Longitudes giuen.

Let the Semicircle ABC be the Synicall arch of the lymbe, and from the concourſe of it and the lymbe C, applie at 7 a diſtance equall to NP, a ruler laide on C



and 7 will cut the Semicircle A B C in Z, take the diſtance C Z, and ſetting one foote in A, with the other in the line A B marke a poynt X, againe making A S equall to F N, and S V equall to I P, applie from C to D a diſtance equall to V A, a ruler laid on C D will cut A B C in Y, make T V equall to C Y, and from C in the arch A B C applie at B a diſtance equall to TX, a ruler layd on CB will cut the limbe in 4, the Circumference C4 is the diſtance ſought for: the other caſes may be all handled after this faſhion.

The 33. Concluſion.

The longitudes and latitudes of any three Starres, or any three places in the earth being giuen, to knowe whether they bee in one greateſt circle or no.

Take the diſtance betwéene the firſt and the middle-moſt, which let be EL, & likewiſe betwéen the middle-moſt and the third, which let be LI, and let the diſtance betwéene the firſt and the third be EG, now if EG be equall to EI they be in one greateſt circle, otherwiſe not.

The 34. Concluſion.

Any vnknowne ſtarre being ſeene, to find the right aſcenſion and declination of it.

Hauing thriſe obſerued the Azimute, and Almicantar or height, you may by the ſeauenth concluſion finde the declination of it, then take the diſtance of it, from any knowen ſtarre, by the declinations taken as latitudes and their diſtance, you may finde the difference of their right aſcenſions ,as the difference of their longitudes, which added or ſubſtracted accordingly from the knowen ſtarres right Aſcenſion, yéeldeth the right Aſcenſion of the vnknowen Starre. Gemma Friſius his chapter anſwering this concluſion, includeth Cometes, but their Parallaxis being neglected, which he regardeth not, neither his working nor this concluſion, no leſſe exact then his working, can duelie performe that hée propoũdeth. In the Moon beſides her Parallax, the ſwiftnes of her motion, will be alſo a let, although Ptolomeye Almag. lib. 7. c. 2. Regiomontanus in Epit. and Copernicus lib. 1. c. vlt. by their Aſtrolabe or Armillæ which Pappus Comment in 5. Alm. calleth Meteoroſcopion, take the place of the Moone to finde the longitude of the ſtars, and peraduenture the methode vſed of Copernicus lib. 2. c. 2. is fitter for that purpoſe.

The 35. Concluſion.

The latitude or amplitude of the Sunnes or anie knowne Starres riſing being giuen with their declination, to knowe the height of the Pole.

ON the land it is eaſie to marke in what points of the Horizon the Sunne or any ſtarre riſeth and ſetteth, and it is a common practiſe at Sea, to ſet the Compaſſe with the Sunne, at his riſing, and going downe, the halfe of the circumferẽce intercepted betwéen thoſe two points, is the amplitude of riſing, reckoned from the Meridian. In the Sunne about the Equinoctiall ſections ſome little errour may happen, which although M. Digges in Scal. Mathem. thinketh worth the correcting, may in handling theſe common inſtruments be nothing regarded. But to the concluſion: let E F, and C G, be eyther of them equall to the declination giuen, and draw the line F G, let the circumference E H, be equall to the amplitude of riſing, coũted from the Eaſt, a ruler laid on H, and A, will cut E I A the Synicall arche of the limbe in I, with your Compaſſe take the diſtance E I, and ſetting one foote in A, with the other toward G, or F, it ſkilleth not which, take a poynt K, a ruler laide on A and K, will cut the lymbe in L, the circumference B L, is the height of the pole.

The 36. Concluſion.

In a Countrie of knowne Latitude, the declination of the Sunne or any Starre being giuen, to know the amplitude or Latitude of riſing.

Let the Circumferences EF, CG be equall to the declination giuen, and B L the height of the Pole, a ruler layd on A and L, will cut FG in K, in E I A the Synicall arch of the lymbe, applie from E to I a diſtance equall to A K, and laying a ruler on A and I, it will cut the lymbe in H, the circumference E H, is the diſtance of riſing from the Eaſt Northward, if G F fall betweene the Equinoctiall and the North Pole Southward, if betweene the Equinoctiall and the Antarticke Pole.

The 37. Concluſion.

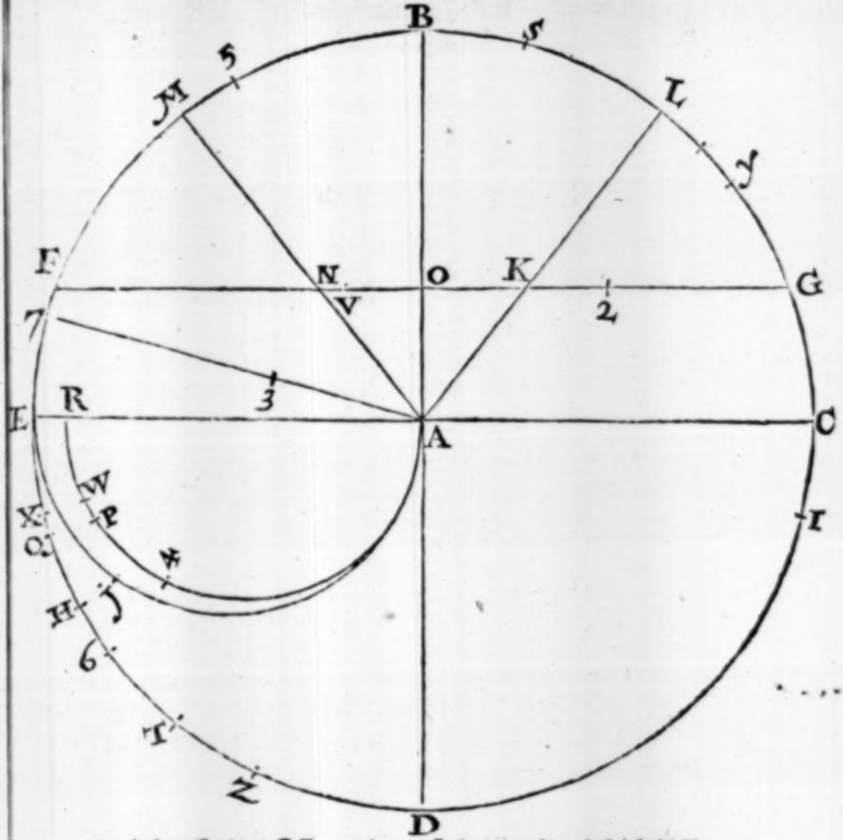
In a Countrie of knowne Latitude, the Amplitude or Latitude of the Sunnes or any Starres riſing being giuen, to finde the Declination.

Let B L be the height of the Pole, and drawe the line A L, let the diſtance of the riſing from the Eaſt, be E H, a ruler laid on A and H, will cut E I A, the Synicall arch of the lymbe in I, take the diſtance E I, and ſetting one foote in A, with the other in the line A L, marke K, then make B M equall to B L, and draw the line A M, in it take A N, equall to A K, a ruler laide on N and K, will cut the lymbe in F and G; either of the Circumferences E F, CG are the declination ſought for.

The 38. Concluſion.

In a Countrey of knowne Latitude, the declination of the Sunne or any Starre being giuen, to finde the Semidiurnall arch, or halfe the time it continueth aboue the Horizon.

Let the height of the Pole be L B, either of the Circumferences E F, C G, equall to the declination giuen, drawing



drawing the line GF, on A and L lay a ruler, which will cut GF in K, take the diſtance OK, and from R in RPA the Synicall arch of GF, applie at P a diſtance equall to OK, a ruler laid on A and P, cutteth the lymbe in Q, if the line FG be betwéene the Equinoctiall and the apparant pole, the Semidiurnall arch ſhall be BEQ, but if it be betwéene the Equinoctiall and the hidden Pole, the Semidiurnall arch ſhall be QD, you may eaſilie ſee in the houre circle, what houres they containe.

A Corollarie.

The poynt Q. if the line GF, be betweene the apparant Pole and the Equinoctiall, ſheweth the time of the riſing: but if it be betweene the hidden Pole and the Equinoctiall, it ſheweth the ſetting: if from C towards D, you take in the lymbe a diſtance equall to EQ, that poynt will ſhew the ſetting, when FG is betweene the apparant Pole and the Equinoctiall, and the riſing, when it is betweene the hidden Pole and the Equinoctiall.

The 39. Concluſion.

The declination and Semidiurnall arch of the Sun, or any Starre being giuen, to finde the height of the Pole.

Let the Circumferences EF, CG, be equall to the declination giuen, and let BEQ, or DQ. be the Semidiurnall arch, a ruler laid on A and Q will cut RPA, the Synicall arch of the line GF in P, make OK equall to the diſtance RP, and laying a ruler on A and K, it will cut the lymbe in L, the Circumference BL is the height of the Pole.

The 40. Concluſion.

By two knowne Starres, whereof the one is in the Meridian, the other in the Horizon, to knowe the height of the Pole or Latitude.

Let the declination of that which is in the Horizon, be equall to either of the Circumferences EF, CG draw the line GF, cutting the Axis AB in O, and let RPA be the

Synicall arch of the line G F, and let the right aſcenſion of that, which is in the Meridian, be diſtant from the néereſt Equinoctiall ſection, ſo much, as Q is from E; now laying a ruler on A and Q, it will cut R P A the Synicall arch of the line F G in P, make O K, or O N, it ſkilleth not which, equall to R P, a ruler laid on K and A, will cut the lymbe in L, the Circumference B L is the height of the Pole.

The 41. Concluſion.

In a Countrey of knowne Latitude, the height and declination of the Sunne being giuen, to knowe the houre of the day, or what it is a clocke.

LEt the Circumferences E F, C G be equall to the declination of the Sunne, and B L and D T the height of the Pole, make either of the Circumferences L S, T H, equall to the height giuen, a ruler layd on S and H, will cut F G in V, in R P A the Synicall arch of F G, applie from R to W, a diſtance equall to O V, a ruler laid on A and W, will cut the lymbe in X. Before Noone the obſeruation being taken, and if the Axis of the world fall betwéene V and the Horizon, then in the quadrant C D, taking from C, a Circumference equal to E X, you ſhal haue ẏ houre pointed forth, but if V fall betwéene the Axis and the Horizon, then take in the Quadrant B C from C, a Circumference equall to E X, and the houre ſhall be poynted out. The obſeruation being taken after Noone, you muſt vſe the Quadrants E D and E B in like manner.

A Caution.

BEcauſe when the Sunne draweth néere the Meridian, you cannot perfectlie diſcerne, whether it bée before Noone, or after Noone, you muſt helpe that matter thus. Take two Obſeruations with ſome pretie diſtance betwéene, and if the laſt be greater then the firſt, then was the firſt before Noone, but if the laſt be leſſer, then was the laſt after Noone.

The 42. Concluſion.

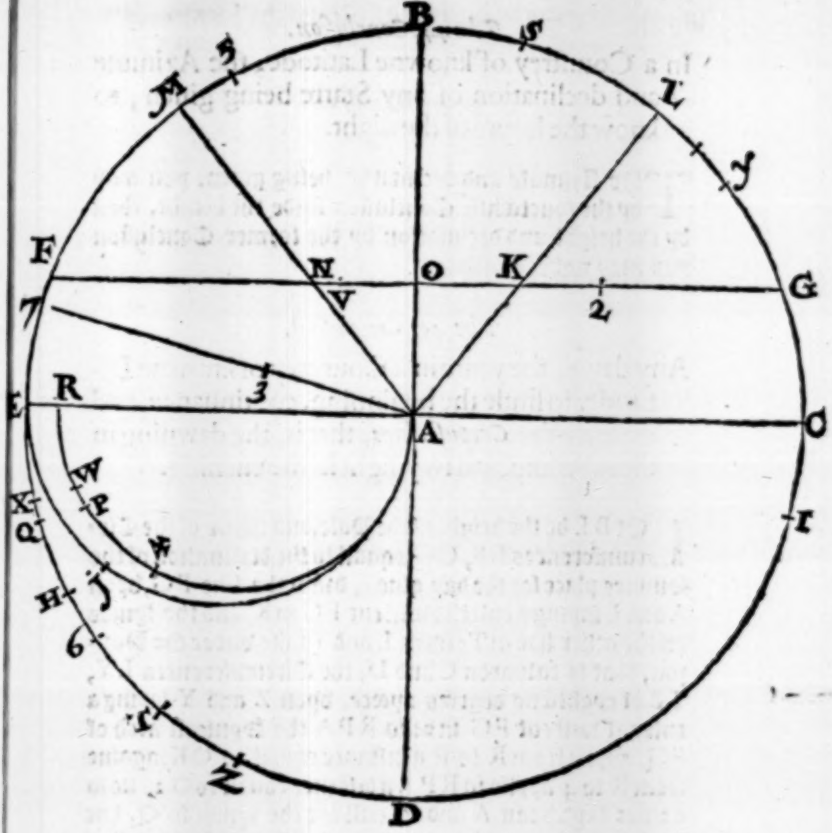
In a Countrey of knowne Latitude, the Azimute and declination of the Sunne being giuen, to find the houre of the day.

BY the Azimute and declination giuen, you may by the 14. Concluſion finde the height thereof, that being had by it and the declination you ſhall by the former concluſion finde the hower.

The 43. Concluſion.

In a Countrey of knowne Latitude, the height and declination of any Starre being giuen, to find the houre of the night.

LEt the Circumferences EF, CG, be equall to the declination of the Starre, drawe the line FG, cutting BA in O; let either of the Circumferences LB, DT bee the height of the Pole, and make the Circumferences LS, TH equall to the height giuen: on S and H laying a ruler, it will cut FG in V: in RWA applie from R to W, a diſtance equall to OV; and laying a ruler on W and A, you ſhall cut the lymbe in X, if the obſeruation be taken before the Starre come to the Meridian, which you ſhall know by the caution of the 41. Concluſion, then take a Circumference equall to EX on the one or the other ſide of C, according to the falling of the poynt V ſhewed in the 41. Concluſion, and ſo ſhall you haue the diſtance of the Starre from the Meridian, or the howre of the Starre, which imagine you finde to be poynted out by T: from T toward the poynt E, take a Circumference



T E G, equall to the ſtarres right aſcenſion, and from G towards B take a Circumference G M equall to the Suns right aſcenſion, a ruler laide on A and M in the howre circle poynteth forth the howre.

The 44. Concluſion.

In a Countrey of knowne Latitude, the Azimute and declination of any Starre being giuen, to know the houre of the night.

The Azimute and declination being giuen, you may by the fourteenth Concluſion finde the height, then by the height and declination by the former Concluſion you may finde the houre.

The 45. Concluſion.

Any day of the yeare in a Countrey of knowne Latitude, to finde the beginning, continuance, and ende of the *Crepuſculum,* that is, the dawning in the morning, and twy-light in the euening.

Let B L be the height of the Pole, and either of the Circumferences E F, C G, equall to the declination of the Sunnes place for the day giuen, draw the line F G, vpon A and L laying a ruler, it will cut F G in K, and the lymbe on the other ſide in T: from L and T take vnder the Horizon, that is towards C and D, the Circumferences L Y, T Z of eyghteene degrees apeece, vpon Z and Y laying a ruler, it will cut F G in 2: in R P A the Synicall arch of F G, applie from R to P a diſtance equall to O K, againe from R to 4 applie in R P A a diſtance equall to O 2, now a ruler layd vpon A and P, will cut the lymbe in Q, but layd on A and 4, will cut it in 6, the Circumference Q 6 in the houre circle will ſhew the continuance of the Crepuſculum. This added to the Sunnes riſing, which you are taught to know by the 38. Concluſion, Cor. ſheweth, when it beginneth in the morning, and added to the time of his ſetting, ſheweth when it endeth in the euening: I neede not tell that it endeth in the morning with the riſing of the Sunne, and beginneth in the euening with his going downe.

The 46. Concluſion.

In a Countrey of knowne Latitude any day in the yeare at any houre aſſigned, to know the height of the Sunne.

Let B L be the height of the Pole, and the Circumferences E F, C G equall to the Sunnes declination for the day giuen, and let E X be the houres diſtance from ſixe, on X and A laying a ruler, it will cut R P A the Synicall arch of the line G F, in W: with your compaſſe take the diſtance R W, and ſetting one foot in O, marke in the line F G a point toward G, if in the morning it be before ſixe, or in the euening after ſixe, but if it be after ſixe in the morning, or before ſixe in the euening, then towards F, as here it is ſuppoſed in the morning after ſixe, and therefore let it be V, on A and V laying a ruler, it will cut the lymbe in 5, make the circumference T 7, equall to L 5, and draw the line 7 A; in it take a line A 3 equal to A V, and laying a ruler on V 3, it will cutte the lymbe in S and H, either of the circumferences L S, or T H are the height deſired.

The 47. Concluſion.

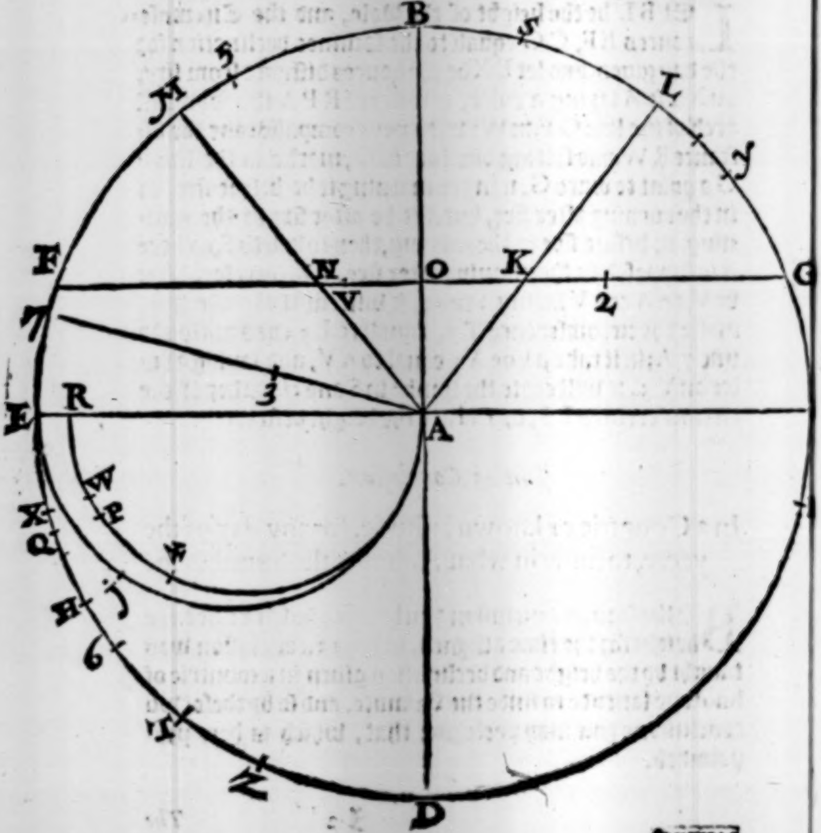
In a Countrie of known latitude, for any day of the yeere, to finde in what Azimute the Sunne is in.

By the former concluſion you learned how to finde the height for the time aſſigned, in the 13. concluſion was taught by the height and declination giuen in a countrie of knowne latitude to finde the Azimute, and ſo by theſe two concluſions you may performe that, which is here propounded.

The 48. Concluſion.

In a countrie of knowne Latitude any day of the yeare at any houre aſſigned, to know how far any determinate point is diſtant from the Meridian.

Let the houre aſſigned be M, and from M by B Eaſtward take a circumference M B G equall to the



Sunnes right aſcenſion for the time giuen, againe from G by E take a circumference G E T equall to the right aſcenſion of the point or ſtarre giuen , the circumference T D is the diſtance thereof from the Meridian, which you deſired.

The 49. Concluſion.

In a Countrey of knowne Latitude at any houre aſſigned any day of the yeere, to know the height of any knowne Starre.

TAke the diſtance of the point or ſtarre at the time giuen from the Meridian, and ſo conſequently from the houre of ſixe, which let be E X, and let E F, C G be equall to the ſtarres declination, draw the line F G, cutting A B in O, then vpon A and X laying a ruler, it will cut R W A, the Synicall arch of F G, in W, with your compaſſe take the diſtance R W, and in the lyne F G from O towards G, if the diſtance from the Meridian be more then ſixe houres, but if leſſe then ſixe houres, as here it is ſuppoſed, then towards F take V O, equall to R W, then laying a ruler on A and V, it will cutte the lymbe in 5, make the circumference T 7 equall to L 5, and draw the lyne 7 A, therein take A 3 equall to the diſtance A V, and laying a ruler on V and B, it will cut the lymbe in the points F and G, eyther of the circumferences E F, C G is equall to the height you deſire.

The 50. Concluſion.

In a Countrey of knowne Latitude at any houre aſſigned any day of the yeare, to know the Azimute of any knowne Starre.

BY the former concluſion you knaw how to finde the height for the time aſſigned, aud by the height and declination, the 13. concluſion will teach you to finde the Azimute as you deſire.

The 51. Concluſion.

In a Countrie of knowne Latitude, to finde the difference Aſcenſional, or the difference of the right and oblique aſcenſion of any poynt of the Eclipticke or any knowne Starre.

Let E W be the height of the Pole, and let either of the Circumferences W I, and W H be equall to the complement of the declination giuen, draw the line HI, cutting the Horizon E C in Y, and the Axis of the world A W in 4, let 6 Z A be the Synicall arch for the line H I, and therein from 6 to Z, applie a diſtance equall to 4 Y, vpon A and Z laying a ruler, it will cut the lymbe in 5, the circumference E 5 is the difference Aſcenſionall which you require.

The 52. Concluſion.

In a Countrey of knowne Latitude to finde the oblique aſcenſion of any poynt of the Eclipticke, or any knowne Starre.

Let the right aſcenſion of the poynt taken by the 20. Concluſion, be the Circumference E B G, accounted from E, the beginning of Aries, and the difference aſcenſionall of the poynt, whoſe line of declination is H I, let be E 5: now if H I be betwéene the apparant Pole and the Equinoctiall, take from G towards E a Circumference G 1, equall to E 5, and F B 1 ſhall be the oblique aſcenſion: but if H I be betwéene the Equinoctiall and the hidden Pole, then from G towards C, take the Circumference G 3 equall to E 5, and then ſhall E G 3 be the oblique aſcenſion ſought for.

A Corollary.

IF you adde a ſemicircle to the oblique Aſcenſion found, that is, if you lay a ruler on 1, or 3 and A, it will in the oppoſite quadrant E D, poynt out the oblique deſcenſion of the poynt, that is oppoſite to the poynt whoſe oblique Aſcenſion you looke.

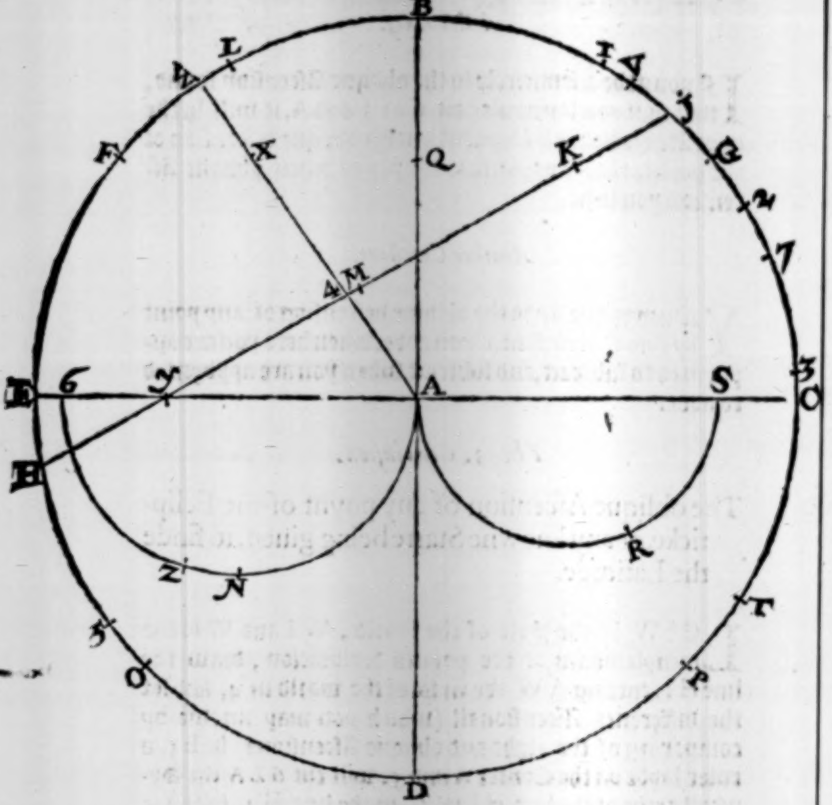
Another Corollary.

YOu may alſo finde the oblique deſcenſion of any point by this Concluſion, if you adde, when here you are appoynted to ſubtract, and ſubtract when you are appoynted to adde.

The 53. Concluſion.

The oblique Aſcenſion of any poynt of the Eclipticke, or any knowne Starre being giuen, to finde the Latitude.

LEt W be the Pole of the world, W I and W H the complements of the poynts declination, draw the line H I, cutting A W the Axis of the world in 4, and let the difference Aſcenſionall (which you may knowe by comparing of the right and oblique Aſcenſions) be E 5, a ruler layde on the Center A and 5, will cut 6 Z A the Synicall arche of the line H I in Z, in the line H 4. take Y 4 equall to the diſtance 6 Z; then laying a ruler vpon A and Y, it will cut the lymbe in E, the Circumference E W is the height of the Pole, or the Latitude ſought for.



The 54. Concluſion.

In a Countrey of known Latitude, any day aſſigned to knowe what poynt of the Eclipticke is in the Meridian in the morning.

Take the oblique aſcenſion for that poynt of the Eclipticke, wherein the Sunne is that day which is aſſigned,

ned, as for example the poynt V, then opening your Compaſſe to the diſtance B C, ſet one foote in V, and with the other from the Weſt towards the Eaſt, or according to the ſucceſſion of the degrees or times of the Equinoctiall marke in the lymbe T, that poynt is the poynt of the Equinoctiall which is in the Meridian: now if by the 22. Concluſion you take the poynt anſwerable to that right aſcenſion in the Eclipticke, it ſhall be the ſame that is in the Meridian.

The 55. Concluſion.

In a Countrey of knowne Latitude any day of the yeere, at any houre aſſigned, to finde what poynt of the Eclipticke is in the Meridian.

LEt the right aſcenſion anſwering the degree of the Eclipticke, which ſerueth the day giuen, be E B V, accounted from E the beginning of Aries, now take the houre diſtance of the Sunne from the Meridian, which let be B W: if the Sunne be not yet come to the Meridian, from V towards C, or from Weſt towards Eaſt, according to the ſucceſſion of the degrees of the Equinoctiall, take a Circumference V 7 equall to B W, 7 ſheweth the poynt of the Equinoctiall, that is in the Meridian, the place of the Zodiacke anſwerable to the right aſcenſion, is alſo in the Meridian with it. But if the Sunne be paſt the Meridian, you muſt take a Circumference equall to B W, contrarie to the ſucceſſion of the Equinoctials degrees, as from V the Circumference B V, and then the poynt of the Eclipticke, which anſwereth the right Aſcenſion B, ſhall be in the Meridian, and the ſame is to be vnderſtoode of the oppoſite poynts.

The 56. Concluſion.

In a Countrey of knowne Latitude any day of the yeere, to know what time any poynt of the Eclipticke, or any knowne Starre riſeth or ſetteth.

TAke the oblique Aſcenſion of the poynt, which let be EBG, and the right Aſcenſion anſwering the poynt, wherein the Sunne is the day giuen, which let be EBT, from the houre of the Sunnes riſing according to the ſucceſſion of the houre circle, take a Circumference equall to GT, and it ſhall poynt out the houre, when the Starre commeth to the Horizon.

The 57. Concluſion.

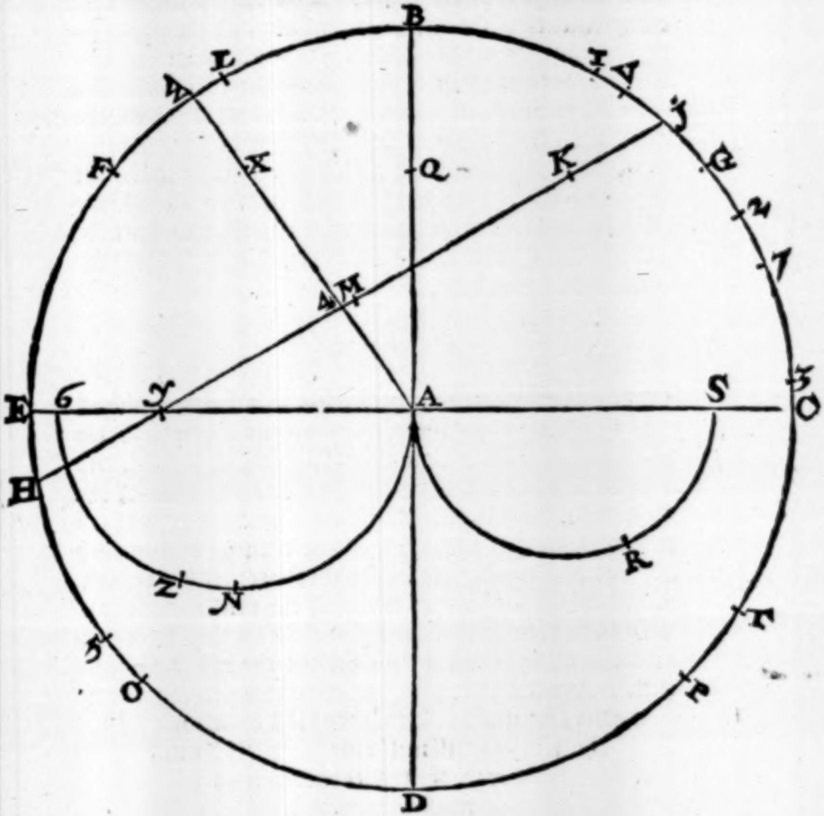
In a Countrey of knowne Latitude to know with what poynt of the Eclipticke, any knowne Starre commeth to the Meridian.

TAke the right aſcenſion of the Starre, and then the poynt of the Zodiacke that is anſwerable thereunto, and that ſhall be the poynt wherewith the Starre commeth to the Meridian.

The 58. Concluſion.

The oblique aſcenſion being giuen, to know the ſituation of the Equinoctiall ſections in reſpect of the Meridian.

LEt the oblique aſcenſion giuen be EB 1, with your compaſſe take the diſtance BC, and ſetting one foote in 1, with the other marke a poynt L, which is the poynt of the Equinoctiall in the Meridian: now for as much as E is beyond the Meridian, it is in the Weſt quarter aboue the Horizon, if it had fallen betweene L and 1, it ſhould haue beene in the Eaſt, the oppoſite ſection is alwaies in the oppoſite Quadrant.



The 59. Concluſion.

In a Countrey of known Latitude to know the Horizontall angle, made by the Section of the Horizon and Eclipticke in any poynt giuen.

Take the oblique Aſcenſion of the poynt giuen, and by it finde the ſituation of the Equinoctiall ſection. Now

if the Section be on the Eaſt ſide of the Meridian, take the complements of the oblique aſcenſion, and the poynt giuen as Latitudes; the Sunnes greateſt declination is the difference of their Longitudes, and by the 30. Concluſion ſeeke the Horizontall angle, as the bearing of the oblique aſcenſion from the poynt of the Eclipticke, that is in the Horizon, and ſo haue you the Horizontall angle, but if the Equinoctiall Section be on the Weſt ſide, you muſt take the complements to the oppoſite poynts of the Eclipticke, and oblique aſcenſion, and with them worke by the Concluſion as is aforeſaide.

To the Reader.

There remaineth for perfecting this Section almoſt 20. Concluſions more, whereof many depend vpō this probleme: viz. In a Countrey of knowne Latitude, any oblique Aſcenſion being giuen, to finde the poynt of the Eclipticke Coaſcending, which yet I haue not found how to perfourme generally, otherwiſe then by taking ſuch helpe of an Eleipſis, as is vſed in the fourteenth Concluſion: in which manner of working the conſtruction will very often exceede the compaſſe of the lymbe, for which and ſome other cauſes I omitte it and the reſt at this preſent. Notwithſtanding if I perceiue hereafter, that thoſe matters be much deſired, they ſhall be adioyned at the next impreſſion: the meane while I muſt intreate the reader to take thus much in good part.

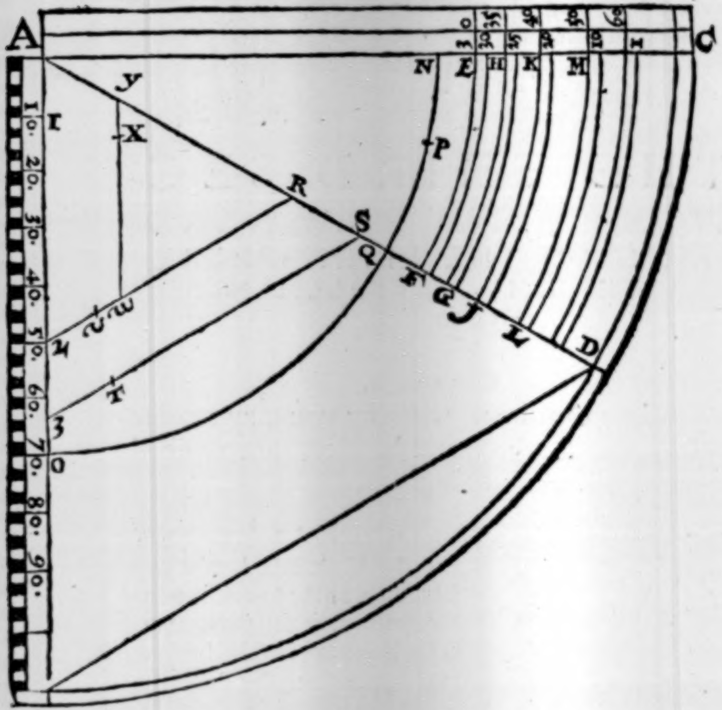
The end of the ſecond Section.

THE THIRD SECTION OF THE NEW HANDLING OF THE PLANISPHERE; WHICH IS A SVPPLEMENT Organicall.

CHAP. I.

To make a Quadrant, whereby you may readiſie know what Degrees and Minutes are contained in any Circumference giuen.

VPon the Center A, deſcribe a quadrant ABC, whoſe lymbe you muſt diuide, as the common manner is, into 90. equall parts or degrées, & euery degrée into halfes; in the lymbe take the quantitie of 30. degrées, which let be CD, and drawe the line AD. In either of the lines AD, or AC, take ſome reaſonable diſtance from the lymbe, as AE, or AF; and vpon the Center A at that diſtance, deſcribe the Circumference FE, then inlarging your compaſſe a little, deſcribe another Circumference, as you ſée at F and E: againe, opening your compaſſe ſomewhat larger, deſcribe another Circumference GH, then extending or contracting the diſtance of your compaſſe, deſcribe a Circumference néere it, as you ſée at GH. In like manner deſcribe two other Circumferences ſomewhat néere together, and diſtant from



GH, as you ſée at IK; and ſo make betwéene EC, FD 30 ſuch liſts, as you ſée at FE, GH and IK. Then take an arch of 59 degrées, which you muſt diuide into 60 equall parts, the ſixtie part of which diuiſion. will diuide two degrées into two vnequall parts: take yͤ two degrées next D, and from that poynt towards D, take a Circumference equall to the greater ſegment you made by diuiding 59 degrées in 60 parts, and vpon that poynt and the Center A laying a ruler, where it cutteth the lyſt next the lymbe, as that beneath LM is, drawe a line, diuiding the lyſt beneath L M, and from that deuiſion applie ſo many degrées in order, as the circumference will admit, till you come ſo neare 1, as you can. Then take 58 degrées, and deuide that circumference into 60 equall parts, the ſixtie part of this deuiſion, falling betwéene two degrées deuideth them into two vnequall parts, againe taking 2 degrées next D, from that point towards D, take the greateſt portion, and laying a ruler on that point and A, where it cutteth the ſecond lyſt from the limbe, draw a line cutting that lyſt, and from that deuiſion marke ſo manie degrées in that lyſt, as the reſidue of the circumference will receiue, then deuide 57 degrées for the third lyſt, 56 for the fourth lyſt, and ſo the degrées in order, till you come to thirtie degrées, and the thirtieth liſt, although if the limbe be deuided into halfe degrées, the thirtieth lyſt, & the deuiſion of thirtie degrées is néedles. Hauing thus deuided 30 lyſtes, in the ſpace without the quadrant, to the ſide A C draw two parallell lines including two ſpaces, & extend one circumference of euery fift lyſt to the vttermoſt parallell, in the ſpace next the ſide of the quadrant A C, at the lyſt next the limbe, ſet one, or 1. at the next circumference extended from the fift lyſt ſet fiue, or 5 in the ſame ſpace, vnder that which is extended from the tenth, ſet 10, and ſo increaſing by 5 to thirty, then deſcending in the ſecond ſpace, at the fift liſt, ſet 35, at the tenth 40, and ſo in order by 5 to 60: then may you thus vſe the quadrant.

To finde what degrees and minutes are contained in any circumference giuen.

VPon the center A, deſcribe in the quadrant A B C, an arch N P O, hauing A N, the ſemidiameter equall to the ſemidiameter of the circumference giuen, & take from it, ſo manie degrées, that you haue a remainder leſſe then thirtie, that is take from it ſo manie times 30 degrées as you can, and if the remainder leſſe then thirty, haue a portion of a degree greater then halfe a degree, taking that remaines with your compaſſe, ſet one foote in Q, and take Q P equall to your remainder; then laying a ruler on A and P, marke the lyſt by whoſe deuiſion the edge paſſeth moſt exactlie, then in the vtter ſpace, on the outſide of A C telling the numbers anſwering that lyſt, you ſhall haue the number of minutes aboue the iuſt degrees. But if your remainder exceed iuſt degrees by leſſe then halfe a degree, then taking that portion with your compaſſe, ſet one foote in N, and with the other marke P, making N P equall to the circumference giuen, then laying a ruler on A, & P, marke the lyſt whoſe deuiſion is cut by the edge of the ruler, and then in the ſpace next A C tell the number of that lyſt from the lymbe, the number ſo found is the number of minutes, aboue the iuſt degrees. If the ſemidiameter of the circumference giuen be greater, then the ſemidiameter of the quadrant, vpon the center of the circumference giuen, deſcribe another, hauing the ſemidiameter equall to the quadrants ſemidiameter, & laying a ruler on the center, and the point giuen, marke where it cut the circumference, hauing the ſemidiameter equal to the quadrants ſemidiameter, and inſteed of the circumference giuen, tranſfer that circumference into the limbe of the quadrant, and then by it proſecute your conſtruction, as is before appointed. Thus may you make one quadrant ſerue inſteed of many vſed by Clauius in his Gnomonia and Aſtrolabe, and ſupplie with 30. diuiſions thoſe 60. which in his conſtruction of the like quadrant out of Iacobus Curtius he appointeth.

CHAP. 2.

To deſcribe a triangle for enlarging or contracting of Scales, and aſſigning any parts, or proportion giuen in any right line.

DRaw on the out ſide of the quadrant, two lines parallell to A B, & deuide the outward ſpace into what number of equall partes you will, which you may doe at pleaſure before you deſcribe the limbe of the quadrant, and in the ſpace next A B at euery fift deuiſion write 5, 10, 15, & ſo forth, according to your number of deuiſions, whereby you may readily tell from A, the parts contained in the deuided ſpace, then drawing the line D B you ſhall vſe it thus.

To cut from a right line giuen any part appointed.

LEt the partes be theſe, which are contained in A 2, and make A R equall to A 2, draw the line R 2, now the line giuen is either greater, or leſſe thē A 2: firſt ſuppoſe it leſſe, & let it be equall to R Y, make R W equall to R Y, draw the line W Y, now laying a ruler on R and 1, one of the parts contained in A 2, it will cut W Y in X, the line X Y is contained in the line W Y, ſo often, as the line A 1, is contained in the line A 2. But if the line giuen be greater then A 2, then make A S equall vnto it, and A R equall to A 2 contayning the parts aſſigned, draw the lines 2 R, and in 2 R take 2 V equall to A 1, one of the parts giuen, then laying a ruler on A, and V, it will cut S 3 in T, the line 3 T is ſo often contained in 3 S as 1 A is contained in A 2: and ſo in both caſes you haue cut off from the line giuen, the part which was required.

A Corollary.

IF any proportion giuen in a right line as the proportion that is betweene 1, 2 and 2 A, you may in like manner finde in any line giuen, for both W Y is to X Y and S T to T 3, as 2, 1, is to 1 A.

tion of a degree greater then halfe a degree, taking that remaines with your compaſſe, ſet one foote in Q, and take Q P equall to your remainder; then laying a ruler on A and P, marke the lyſt by whoſe deuiſion the edge paſſeth moſt exactlie, then in the vtter ſpace, on the outſide of A C telling the numbers anſwering that lyſt, you ſhall haue the number of minutes aboue the iuſt degrees. But if your remainder exceed iuſt degrees by leſſe then halfe a degree, then taking that portion with your compaſſe, ſet one foote in N, and with the other marke P, making N P equall to the circumference giuen, then laying a ruler on A, & P, marke the lyſt whoſe deuiſion is cut by the edge of the ruler, and then in the ſpace next A C tell the number of that lyſt from the lymbe, the number ſo found is the number of minutes, aboue the iuſt degrees. If the ſemidiameter of the circumference giuen be greater, then the ſemidiameter of the quadrant, vpon the center of the circumference giuen, deſcribe another, hauing the ſemidiameter equall to the quadrants ſemidiameter, & laying a ruler on the center, and the point giuen, marke where it cut the circumference, hauing the ſemidiameter equal to the quadrants ſemidiameter, and inſteed of the circumference giuen, tranſfer that circumference into the limbe of the quadrant, and then by it proſecute your conſtruction, as is before appointed. Thus may you make one quadrant ſerue inſteed of many vſed by Clauius in his Gnomonia and Aſtrolabe, and ſupplie with 30. diuiſions thoſe 60. which in his conſtruction of the like quadrant out of Iacobus Curtius he appointeth.

CHAP. 2.

To deſcribe a triangle for enlarging or contracting of Scales, and aſſigning any parts, or proportion giuen in any right line.

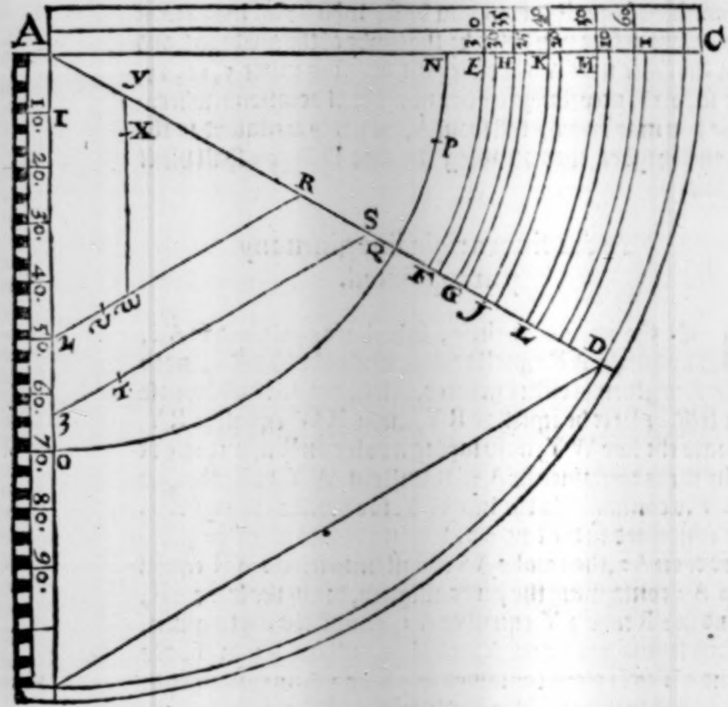
DRaw on the out ſide of the quadrant, two lines parallell to A B, & deuide the outward ſpace into what number of equall partes you will, which you may doe at pleaſure before you deſcribe the limbe of the quadrant, and in the ſpace next A B at euery fift deuiſion write 5, 10, 15, & ſo forth, according to your number of deuiſions, whereby you may readily tell from A, the parts contained in the deuided ſpace, then drawing the line D B you ſhall vſe it thus.

To cut from a right line giuen any part appointed.

LEt the partes be theſe, which are contained in A 2, and make A R equall to A 2, draw the line R 2, now the line giuen is either greater, or leſſe thẽ A 2: firſt ſuppoſe it leſſe, & let it be equall to R Y, make R W equall to R Y, draw the line W Y, now laying a ruler on R and 1, one of the parts contained in A 2, it will cut W Y in X, the line X Y is contained in the line W Y, ſo often, as the line A 1, is contained in the line A 2. But if the line giuen be greater then A 2, then make A S equall vnto it, and A R equall to A 2 contayning the parts aſſigned, draw the lines 2 R, and in 2 R take 2 V equall to A 1, one of the parts giuen, then laying a ruler on A, and V, it will cut S 3 in T, the line 3 T is ſo often contained in 3 S as 1 A is contained in A 2: and ſo in both caſes you haue cut off from the line giuen, the part which was required.

A Corollary.

IF any proportion giuen in a right line as the proportion that is betweene 1, 2 and 2 A, you may in like manner finde in any line giuen, for both W Y is to X Y and S T to T 3, as 2, 1, is to 1 A.



Another Corollary.

IN like manner you may inlarge, or contract any Scale at pleaſure: firſt taking the halfe, third, fourth, or what part elſe you will of it, by this probleme, and then againe diuide that part ſo taken into the parts whereinto the Scale is diuided, and by this Scale ſo contracted you may make a plat, whoſe ſides correſpondent to the ſides of the firſt plat, ſhall be halfe or a third or a fourth part, or any number you firſt tooke, likewiſe by the ſecond caſe you may enlarge them at your pleaſure.

You may alſo diuide any line giuen into more parts then are in the ſide A B, which how to performe with ſome cautions for auoyding error in mechanicall practiſe, I will reſerue till another edition.

Chap. 3.

Of the Meridian line, the variation of the Compaſſe and the height of the Pole.

A lemma

About a Circle giuen to deſcribe a Quadrant.

LEt the Circle giuen be BCDE, whoſe center let be A, and let the Diameters BD, CE be perpendicular one to another, then extending one of them, namely BD, make AG equall to the diſtance BC, vpon G as a Center at the diſtance GB, deſcribe an arch FBH, and from G draw two touch lines GLF, and GMH: I ſay that GFH is a Quadrant, circumſcribed about the circle BCDE, vz. the lines FG, GH, & the circumference FBH, do only touch it.

If you make the ſemidiameter of the quadrant to another line, as DB the Diameter of any circle giuen, is to the diſtance BC, ſubtending a quadrant of the ſame circle, the exceſſe of the Dameter aboue that line, is the ſemidiameter of the circle to be inſcribed in that quadrant.

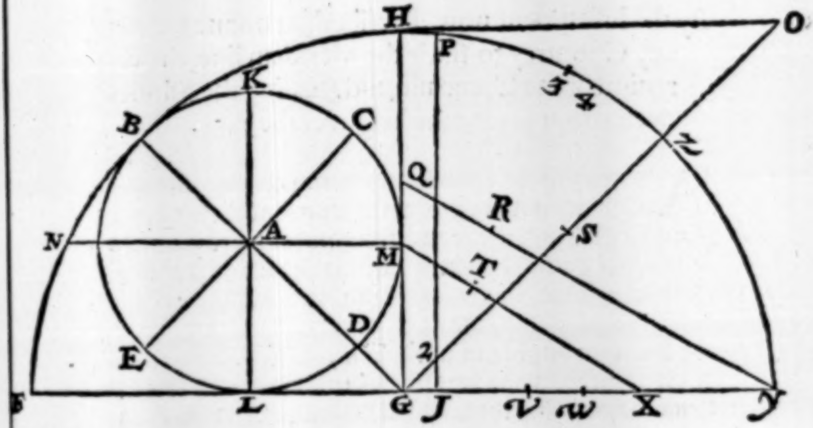
The vſe and making of an inſtrument tractable as well at Sea, as at Land, wherein the ſhadow of the Sunne ſhall at one inſtant poynt out his magneticall Azimute and height.

VPon the center A, deſcribe a circle BCDE, and by the former Lemma, about it deſcribe a Quadrant GFH: and draw the lines AL, AM parallell to the ſides FG, and GH, then diuide the lymbe FBH into 90. degrées, beginning at F, this being done, cut out a circle ſomewhat

leſſe

leſſe then the circle BCDE, but concentricke vnto it. Then take an Iſoſcheles triangle GHO; hauing the angle at H a right angle, and either the ſides including it equall to the ſemidiameter of the Quadrant, this triangle muſt be placed vpon the line GH, in ſuch manner, as the poynt G agree iuſt with the center of the quadrant, and ſo that the plaines of the quadrant and triangle be perpendicular one to the other: then muſt there in ſome place of the line FG be ſet a ſtanderd or plate (it will be beſt betweene L and G) ſo that one of the edges ſtanding iuſt vpon the line GF, be perpendicular vnto it, and the whole plate it ſelfe parallell to the forenamed rectangle triangle. On this ſtandard, or ſomewhere in the triangle on that ſide, which reſpecteth F, you muſt hang a plumbe line, and if you will ſet another plate vpon FG, ſome where about F, making his ſection with the quadrant in the line GF, and alſo perpendicular vnto the plaine of the quadrant, you may by a plumbe line hanged vpon this plate, or ſtandard, and the other plumbe line holde the quadrant GFH, both at Sea and Land preciſelie leuell with the Horizon. Beſides this you muſt make a round boxe, hauing the circle in the bottome diuided into 360 degrees, or euery quadrant into 90, as you like beſt, which boxe muſt be faſtened vnto the quadrant in ſuch manner, as the two Diameters croſſing one another at right angles, haue the one, one end directly anſwering the poynt L, & the other another end likewiſe preciſely anſwering the point M; in the center of this boxe, you muſt ſet a pinne to beare a needle touched with a very good Loadſtone, making the needle of ſuch length, as it may freely play in the boxe; this boxe muſt be couered with a glaſſe to keepe it from duſt and other hurt, as in dials and compaſſes is vſed. The ſtandards and the triangle may be ſo ſhouldered to the quadrant, that you may take them off, and put them on when you will; the manner how, I need not to ſtand vpon, euery workeman can eaſily deuiſe how, and alſo ſupplie euery particular circumſtance in the ma-

king



king of this inſtrument required, which I very willinglie referre to their handines and ſkill, onely I muſt warne them very carefullie to place the triangle preciſely perpendicular to the quadrant, with the poynt of the acute angle agreeing with the center, and that the endes of the Diameters in the bottome of the boxe, doe very exactly reſpect the poynts L and M in the ſides of the quadrant, you ſhall vſe this inſtrument thus. Holde the quadrant by the plumbe lines leuell with the Horizon, and turne the triangle towards the Sunne, till the ſhadowe of the plate or Standard that is next G, doe fall preciſely vpon the line GF, or (if you will place it ſo) vpon ſome line parallell vnto it, the ſhadowe in the lymbe of the quadrant will cut off, accounting from F vnto it, a circumference equall to the height of the Sunne. At the ſame time if you marke the poynt M, and the circumference that is betweene it and the South ende of the needle, that is the diſtance of the Sunne from the South of the Magnet, or the Magneticall Azimute of the Sunne reckoned from the South.

By the inſtrument now deſcribed, at noone tyde in any Countrey to finde the Meridian line, the variation of the Compaſſe, and (hauing the Sunnes declination giuen) the height of the Pole.

ALthough it be a matter not very eaſie to finde preciſely when it is noone, or the Sunne at the hyeſt, yet may you geſſe when it commeth ſomwhat neere it, as it is commonly practiſed by Sea-men, which vſe at that time with their Aſtrolabe or croſſe ſtaffe, to make foure or fiue ſundry obſeruations, and amongſt them take the hieſt for the Meridian height: in like manner when it draweth to be about noone, make ſundrie obſeruations with this inſtrument, marking the height of the Sunne, and his Magneticall Azimute, as was euen now ſhewed in the vſe of the inſtrument, the greateſt height is the Meridian height, and the Diameter A M doth preciſely anſwere the Meridian line, the circumference intercepted betweene it and the ſouth poynt of the needle, is the variation of the compaſſe, whether Eaſt or Weſt, is eaſilie determined by the ſide of A M, on which the needle reſteth. Now the Meridian height being giuen, with the declination, you haue been taught in the tenth Concluſion of the ſecond Section, how to finde the Latitude or height of the Pole. The common manner of finding it by adding or ſubtracting of the declination is more artificiallie handled by Nonnius lib. 2. cap. 9. de Reg. Nauig. then hath to my knowledge been hitherto publiſhed in Engliſh, and therfore I thinke it not amiſſe to tranſlate his words, which be thus:

We muſt obſerue the ſunne, when he is higheſt aboue the Horizon, which is at noone, then if the ſhadowes of bodies perpendicular to the Horizon be caſt that away, that the Sunne declineth, in the day of your obſeruation, you muſt adde the complement of his greateſt height to the declination, ſo haue you the degrees and minutes of the latitude, North, if the Sunnes declination be North, South, if it be South.

But if the ſhadowes be caſt to the contrarie part, then you muſt compare the Sunnes declination with the complement of his height, which if you finde equall, the Zenith is in the Equinoctiall: but if they be vnequall, ſubtract the leſſe from the greater, & the remainder is the latitude, named of the declination, if the declination be greater, but if leſſe, of the contrarie part or ſide.

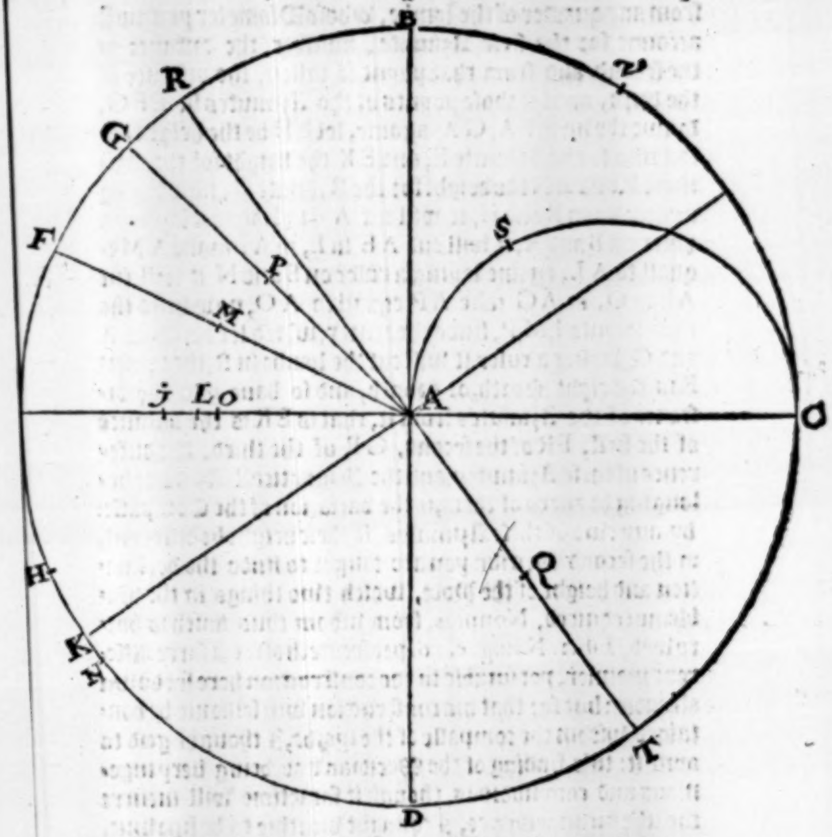
When the ſunne hath no declination, the complement of his greateſt height is the latitude, and toward that part or pole, towards which the ſhadowes are caſt: you may know by the Mariners Compaſſe whether the ſhadowes be caſt North or South. When the Sunne is in the Zenith, the declination, if it haue any, is the latitude: thus much Nonnius.

By the ſame inſtrument two obſeruations being taken; when the Sun hath equall altitudes, to finde the Meridian line, the variation of the compaſſe, and (the Sunnes declination beeing giuen) the height of the Pole.

The Sunne doth not alwaies ſhine at noone, & therefore at other times you may helpe your ſelfe thus. Make an obſeruation with your inſtrument marking the height of the Sunne, and the circumference intercepted by the point of the needle, and that diameter, which is perpendicular to that ſide of the quadrant, on which the triangle ſtandeth, and doe this if you will foure or fiue times before noone: in the after noone marke, when the Sun commeth againe to the ſame height, which it had anie time, when you made your obſeruations in the forenoone, and againe how many degrees are betweene the Diameter that is perpendicular to the ſide of the Triangle, and the North point of the needle, then compare that found in the forenoone, with that you found in the afternoone: if they be both on the ſame ſide of the needle, ſubtract the leſſe frō the greater, and the halfe of the reſidue pointeth forth the right North, to which if you adde the exceſſe of the greater magneticall Azimute aboue the leſſe, you haue the variation of the Compaſſe, Eaſtward, if the firſt obſeruation were left, Weſtward, if the ſecond. But if the one be on the one ſide, and the other on the other. then adde both the circumferences together, & of them both take the half, that point determineth the preciſe north: with this halfe compare the laſt obſeruation, and if it be greater, the variation is Eaſtward, but Weſtward if it be leſſe. Now the Meridian line being found, you know the Azimute, wherein the Sunne was at the time of your obſeruation, and you alſo tooke his height, which two being giuen with his declination, you may finde the latitude, as was ſhewed in the 8 and 10 concluſions of the ſecond Section.

By the ſame inſtrument three obſeruations beeing taken, whereof two bee, when the Sunne hath equall altitudes, to finde the Meridian line, the variation of the Compaſſe, the declination of the Sunne, and the height of the Pole.

YOur three obſeruations being taken as is required, you haue two of them when the Sunnes heights be equall, by which you are taught in the former probleme how to finde the Meridian line, and the variation of the Compaſſe, the Meridian line being found, you may knowe the diſtance of both thoſe Azimutes from it, which haue different Altitudes, by which two Azimutes and their altitudes, the ninth and tenth Concluſions of the ſecond Section wil ſhew you, how to finde the declination of the Sunne, and the Latitude.



By the ſame inſtrument three obſeruations being taken howſoeuer, to finde the Meridian line, the variation of the Compaſſe, the declination of the Sunne, and the height of the Pole.

Hauing taken by your inſtrument in three obſeruations, the heights and diſtances of their Azimutes:

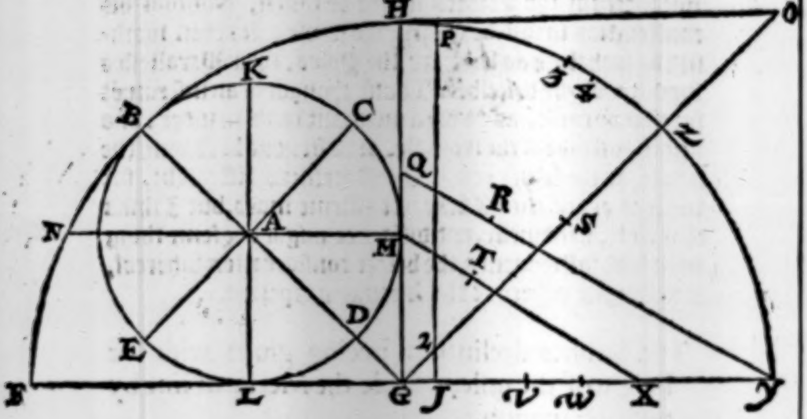
from any quarter of the lymbe, whoſe Diameter you muſt account for the firſt Azimute, number the diſtance of the ſecond, and from that poynt ſo taken, the diſtance of the third, and let thoſe poynts of the Azimutes be E F G, drawe the lines F A, G A; againe, let E H be the height belonging to the Azimute E, and E K the height for the Azimute F, and E N the height for the Azimute G; now laying a ruler vpon B and H, it will cut A E in I, againe laying a ruler on B and K, it will cut A E in L, in A F make A M equall to A L, againe laying a ruler on B and N, it will cut A E in O, in A G take A P equall to A O, now vnto the thrée poynts I, M, P, finde the center, which let be Q, on A and Q laying a ruler, it will cut the lymbe in R, that point R is the right North, or South, and ſo haue you the diſtance of the Azimutes from it, that is E R is the diſtance of the firſt, F R of the ſecond, G R of the third, the difference of theſe Azimutes, and the Magneticall Azimute belonging to euery of them, is the variation of the Compaſſe: by any two of theſe Azimutes, ſo their height be different, in the ſecond Section you are taught to finde the declination and height of the Pole, which two things in the probleme required, Nonnius, from whom thus much is borrowed, Lib. 2. Nauig. c. 16. proſecuteth after a farre different manner, yet ſutable to the conſtruction here ſet downe alreadie: but for that his conſtruction will ſeldome be contained within the compaſſe of the lymbe, I thought good to omit it: this finding of the Meridian line, being very ingenious and commodious, though it ſometime will incurre the like inconuenience, I thought worthie to be knowne. Clauius hath another way to performe the things required, but nothing eaſier then this of Nonnius. For both of them about the Equinoctiall will produce the conſtruction hugely without the compaſſe of the lymbe, and in Nonnius his way, the Sunnes parallell will differ little from a right line, ſo that you muſt vſe a peculiar inſtrument for to deſcribe it, and yet are you nothing the nearer for finding

ding

ing of the center. Therfore if at Sea the Azimutes and almicanters of the Starres might be taken, Nonnius his conſtruction would be of farre more vſe: for then working by ſuch ſtars as be neare the Poles, their Parallelles would eaſily be deſcribed. I haue thought of an inſtrumēt for that purpoſe, as to vſe a quadrant with an index, and ſights, inſteade of the triangle, or to fit your boxe with the needle, at the lower end of the Marriners Aſtrolabe, for want of experience I dare not affirme much, but I think that Arte, handineſſe, and diligence might doe ſome thing with ſuch inſtruments, the better conſideration whereof, I willinglie referre to the Seamans experience.

The Sunnes declination beeing giuen with the height of the pole, to finde the Meridian line by one obſeruation.

PLacing your quadrant with the triangle vppon anie plaine made leuell with the Horizon, turne it as is appointed for the finding of the height, and by the ſide, on which your ſtandardes are placed, drawe a right line: by the height, which you then finde, in a countrie of knowne Latitude the Sunnes declination beeing giuen, you are taught in the ſecond ſection Concluſion 13, to find the Azimute, which being done, deſcribe a circle vppon a center taken in the former line, and from the line taking accordingly a circumference anſwering the Azimute, the line which ioyneth that point, and the center, is the Meridian line. Clauius hath two other waies to do this: one Gnomon. lib.1. cap.23. the other in his Aſtrolabe lib. 3. Can. 12. and a third I haue found, but none to be preferred before that which is here propounded, notwithſtanding if this booke bee printed againe, thoſe three alſo ſhall bee adioyned.



Chap. 4.

Of Mappes or Chartes and Nauticall directions.

Anie line being giuen, to finde another line, vnto which the line giuen ſhall haue that proportion, that the Meridian hath to any Parallell.

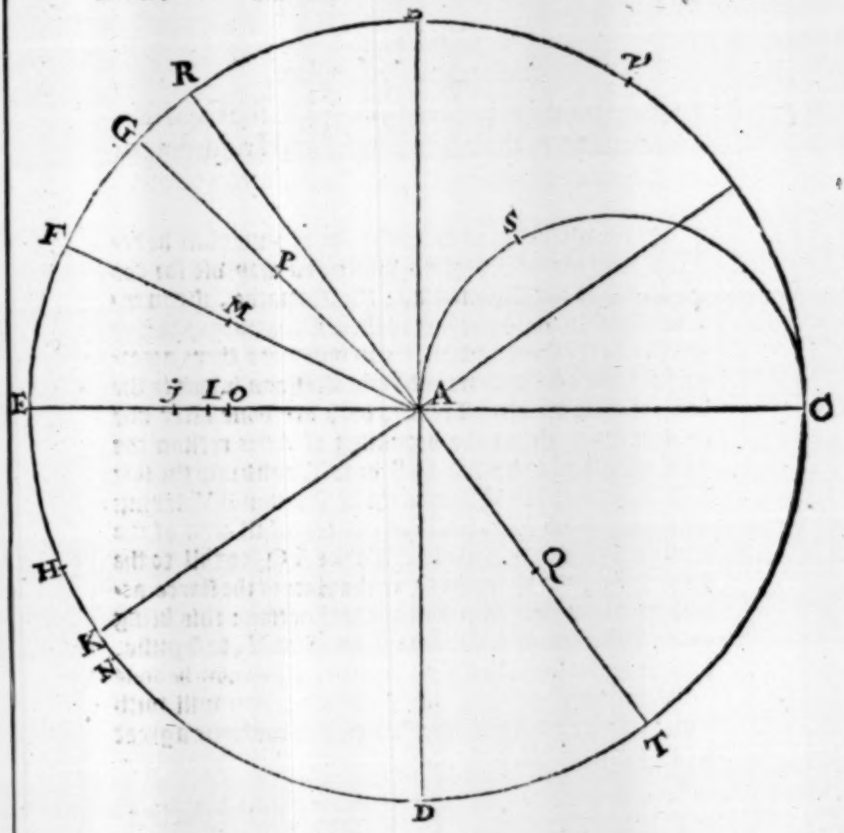
Vpon the center G deſcribe a ſemicircle FHY, and let HG be perpendicular to FY. Let FB, YZ be equall to the diſtance of the Parallell from the Equinoctiall, and draw the lines BG, GZ: let GA be equall to the line giuen, and in GZ take GS, equall to GA, laying a ruler on A, and S, it will cut GH in M, drawe the line AM. I ſay GA, or the line giuen hath the ſame proportion to AM, that the Meridian hath to the Parallell, whoſe diſtance from the Equinoctial is FB, which was required to be giuen. I thought good to ſet downe this exacte and readie way, becauſe that, which Mercator deſcribeth in the proeme of his reformed tables for Ptolomey, is more troubleſome, and leſſe exact.

To deuide any line, or the ſide of your quadrant, or your ruler as that line is deuided, which in *Gerard Mercators* Generall mappe, and his directorium doth anſwere the Meridian.

DEuide the line you take for the ground of this worke firſt into 10 equal parts, and then euery one into fiue parts, imagining euerie one of the fift partes to be deuided into twentie: beſides take euerie fift part for a degrée in longitude: then to finde the degrées of latitude anſwerable vnto it doe thus: in G Y the ſemidiameter of the quadrant G H Y take G I equall to one degrée of longitude, and by I, draw the line I P parallell to G H; then laying a ruler on G and euery degrée of the limbe, accounting from Y marke where it cutteth I P, the line intercepted betwéene thoſe ſections and G doe anſwere the correſpondent degrée: as for example, I take a degrée at Z, vz. the 45 degrée, then I lay a ruler on G and Z, which cutteth I P in 2, the line G 2 in the Meridian anſwereth the point Z, or is the 45 degrée: Now hauing marked theſe ſections for euerie degrée in the quadrant, tranſfer them one after another into your ruler, or the ſide of your quadrant, that is at one end of your quadrant, take a line equall to that, which anſwereth one degrée, adde to it, that which anſwereth the ſecond, to that put that, which anſwereth the third, and ſo till you come to the end of that line, which not being able to receiue all, draw another line, and proſecute the like conſtruction in that, and ſo in the third, and forth till you haue tranſferred all the lines anſwering your degrées. If in this tranſferring, your deuiſions agrée not iuſt with the ends of your lines, you muſt take onelie the ouerplus of the laſt deuiſion in the beginning of the next line, and ſo proceed as is aforeſaid. Now hauing your lines thus deuided, and another deuided to the ſame parts that the ſide of your quadrant is, being parallell to them, & all perpendicular to one right line, you may readilie know what equall partes are contained betweene any two of your degrees taken howſoeuer, whereby you may performe all the vſes of Mercators Directorium. Thus for example.

The Longitudes and Latitudes of any two places being giuen, to finde their direction, commonlie called the Rumbe.

Take the equall parts contained, as well in the difference of the latitudes, as in the diffrence of their longitudes, and ſee whether both be leſſe then the ſide of your quadrant, or no: firſt ſuppoſe they be leſſe, and let the geater be X G, the leſſer G M: draw the line X M, deuide G X into two equall parts in V, then opening your Compaſſe to the diſtance V G, and keeping one foote in V, with the other marke T, in M X; on T and G laying a ruler, it will cut the limbe in 4. Now if the difference of the Latitudes be leſſe then the difference of the longitudes, 4 Y is the diſtance of the rumbe from the Meridian, but if the difference of the longitudes be leſſe, then is 4 P the diſtance of the rumbe from the Meridian. But now ſuppoſe that one or both the differences, be greater then the ſide of your quadrant, then by the rule of proportions, you muſt finde a line, vnto which the leſſer is, as the greater is to the ſide of the quadrant, or make the ſide of the quadrant to another line, as the greater is to the leſſer, namelie let G Y be vnto G Q, as the greater difference is to the leſſe, and draw the line Q Y: deuide G Y into two equall partes in W, then opening your Compaſſe to the diſtance W G, and keeping one foote in W, in Y Q marke R, a ruler laid on G and R, will cut the limbe in 3: now as before, if the difference



ference of the longitudes be the greater, then is H3 the diſtance of the rumbe from the Meridian, South, if the place reſpected be South, North, if it be North, and ſo likewiſe East, or Weſt.

CHAP. 5.

Of the backe of your plate.

To inſcribe in the backe of your plate the fixed ſtars according to their Longitudes and Latitudes, or declinations and right aſcenſions, as you pleaſe.

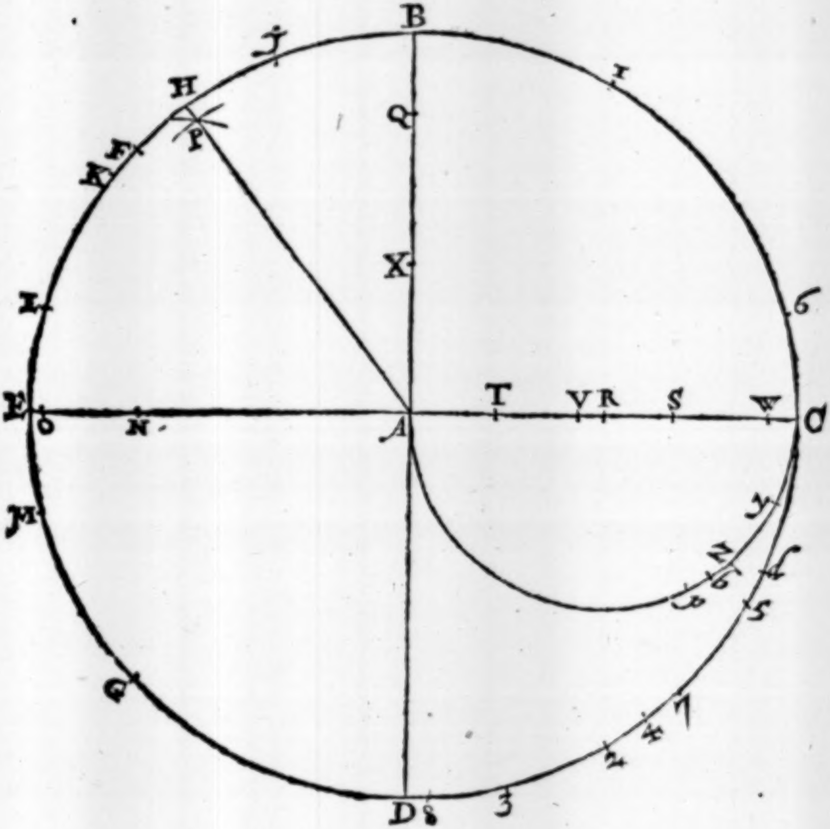
LEt the utter edge of the backe ſide of your plate be devided into 360 degrees, which you may uſe for the Zodiacke, or the Equinoctiall; the Zodiacke, if you inſcribe the Starres according to their Longitudes and Latitudes, or the Equinoctiall, if you will place them according to their declinations and right aſcẽſions, which is the beſt, for thoſe are oftneſt in uſe, both are done after one manner thus. From the beginning of Aries reckon the right aſcenſion, as from E by B unto T, and draw the line A T, then from B to V, reckon the declination B V, laying a ruler on V and A, it will cut the Synicall arch of the limbe A S C, in S, in the lyne A T take A Q equall to the diſtance A S, and the point Q is the place of the ſtarre according to his right aſcenſion and declination: this being done, ſet downe by it the name, and S or N, to ſignifie, whether it decline North, or South. This may be done ſo ſleightlie, that you may rub it out when you will with a wet pumice, and yet deepe enough to continue a great while for your uſe.

To finde the longitude and latitude, or the declination and right aſcenſion of ſuch ſtars as bee placed on the back of the plate.

VPon the center of the plate, and the point of the ſtar lay a ruler, where it cutteth the limbe, is the right aſcenſion reckoned from the vernall Section, or the longitude, if they be placed for the Zodiacke. As for example:

lay

Place this figure in ſteade of the figure in folio 35.



lay a ruler on A and Q, it will cut the limbe in T, the circumference EBT is the right aſcenſion of Q. Now if in ASC the Synicall arch of the limbe, you applie from A to S, a diſtance equall to AQ, and lay a ruler on A and S, it will cut the limbe in V, the circumference BV is the declination of the ſtarre placed at Q, or the latitude, if they were placed according to the longitudes, & latitudes: by the letter S or N you ſhall know whether it bee North, or ſouth. And that you may be furniſhed for theſe two laſt problemes, I haue ſet downe on the other ſide a table out of Clauius, contayning certaine fixed ſtarres, both with their longitudes and latitudes, and their declinations and right aſcenſions, calculated for this yeare 1600. And thus much at this time, for the Planiſphere, which hereafter I meane to increaſe with more concluſions, & problemes, and could haue now enlarged it with handling menſurations, Synicall calculations and dialling: but thoſe thinges ſeemed ſomewhat farre from my principall purpoſe, and therefore I will intreate the reader to accept thus much onely as now is deliuered, and ſo for this time I end.

The end of the new handling of the
Planiſphere.

A Table of fixed Starres out of *Clauius*, calculated for the yeere 1600. compleat.

Bignes	Names.	Place in the Zodiacke or Longitude			Their Latitude		The part.	The declination.		The part.	The right Aſcenſion	
3	The Rains former horne.	Aries	28	5	7	20	N	17	39	N	23	20
	Meduſaes head.	Taur	21	5	23	0	N	40	5	N	40	55
	Bulles eye.	Gem.	4	5	5	10	S	15	56	N	63	6
	Orions right ſhoulder.	Gem.	23	25	17	0	S	6	21	N	83	41
	The Goate.	Gem.	16	25	22	30	N	45	9	N	72	6
	The great dogge.	Can.	9	5	39	10	S	15	54	S	97	19
	Hydraes bright Starre.	Leo.	21	25	20	30	S	5	4	S	137	19
	Lions hart.	Leo.	23	50	0	10	N	13	44	N	146	19
	Lions tayle.	Virg.	15	55	11	50	N	16	26	N	171	49
	The Virgins ſpike.	Lib.	18	5	2	0	S	8	58	S	195	55
	Arcturus.	Lib.	18	25	31	30	N	21	49	N	209	23
	Scorpions heart.	Scor.	4	5	4	0	S	24	57	S	241	16
	Harpe.	Cap.	8	45	62	0	N	38	40	N	275	15
	Laſt in Aquarius water.	Aqu.	28	25	23	0	S	35	24	S	339	56
	Swannes tayle.	Piſc.	6	35	60	0	N	44	8	N	307	22
	Pegaſus legge.	Piſc.	23	35	31	0	N	25	44	N	341	0

Errata.

Page 3. line vlt. *Analemma*. p. 6. l. 6. *Maurolycus*. p. 10. l. 9. *Friſius*. p. 13. l. vlt. *Motus raptus*. p. 14. l. 31. Zenith, appearing. p. 16. l. 33. from the Zenith, which. p. 17. l. 2. 5. 7. for Z make L. p. 22. l. 1. blot out pan. and l. 11. N L. p. 23. l 13. 25. for Z make L. ibid. l 20. Tropickes. p. 24. l. 26. there maketh angles. p. 25. l. 12. and by two of thoſe. p. 26. l. 9. ſetting Ianuarie. p. 32 l. 26. 27. for Q make 7. p. 33. l. 10. for 3 & 3 make 8 & 8. ibid. l. 13. for G make E. p. 34 l. 4. 5. for T make V. l. 13 for F make E. l. 27. which let be C 1, 1 I, and I K. l. 28. 29. for B make P. p. 36 l. 2. 7. for B make P. l. 5. for 12. make 2. l. 8. for 2. and D make P. p. 38. l. 18. and H I, cutting. p. 40. l. 23. for K make B. In the figure of the 39. page place 3. on the other ſide of D.

C 18810

38396

REPRODUCED FROM THE COPY IN THE

HENRY E. HUNTINGTON LIBRARY

FOR REFERENCE ONLY. NOT FOR REPRODUCTION